USGS
Sound Waves
Coastal and Marine Research News from Across the USGS
http://soundwaves.usgs.gov/

Spotlight on Sandy

Updates on USGS Research to Support Restoration and Recovery from Hurricane Sandy

More than a year after Hurricane Sandy struck the U.S. east coast on October 29, 2012, the U.S Geological Survey (USGS) continues to study the devastating impacts of the storm. Aided by supplemental funds from the Department of the Interior (DOI; <**http://soundwaves.usgs.gov/2013/12/research.html**>), scientists are generating critical information to aid the recovery of coastal areas and to help communities become more resilient to future extreme storms. Three articles that describe some of this USGS work follow in the debut of **Spotlight on Sandy**—a new regular feature of *Sound Waves*.

Decade of Fire Island Research Available to Enhance Understanding of Future Coastal Changes

By Cheryl Hapke and Christian Quintero

A new resource about Fire Island, New York, is now at the fingertips of coastal managers, planners, and the public, who will find it useful for understanding and predicting future changes on the island.

Fire Island is the longest of the barrier islands that lie along the south shore of Long Island, New York. Most of the island is part of Fire Island National Seashore and is a unique and important recreational and ecosystem resource. The U.S. Geological Survey (USGS) has created *Fire Island Coastal Change* (<**http://coastal.er.usgs.gov/fire-island/**>), a public website that details a decade's worth of research focusing on changes to the beaches and dunes of the barrier island and understanding what influences their change.

Fire Island was severely affected by Hurricane Sandy in October 2012. More than a year later, the USGS continues studying the changes caused by Sandy and producing information to aid the recovery process and help communities become more resilient against future storms.

"The website is intended to provide our Federal, State, and local partners and stakeholders with an access point to the large body of science we have produced, including the findings of the research that has been conducted at Fire Island," said **Cheryl Hapke**, USGS research geologist and a principal investigator in USGS Fire Island research.

*View looking east toward Fire Island lighthouse. Extensive flat, sandy areas in the photograph are overwash sheets where the dunes were leveled during Hurricane Sandy. USGS photograph by **Cheryl Hapke**.*

In addition to understanding the impacts of Hurricane Sandy, USGS scientists are integrating analyses of short- and long-term coastal change to better understand what factors affect coastal shorelines and how geologic controls, sea-level rise, and human activities contribute to shoreline vulnerability. Results of the research at Fire Island are applicable to other barrier-island systems.

"Barrier islands are dynamic systems that also provide protection from future storms to the built environment," Hapke said. "A thorough understanding of the long-term and short-term evolution of barrier islands can lead to models that better predict future changes to the coastal system at Fire Island."

As a result of Hurricane Sandy, beaches and dunes on Fire Island lost more than half of their pre-storm volume. Field surveys conducted immediately after Sandy documented low, flat beaches and extensive dune erosion (see related *Sound Waves* story at <**http://soundwaves.usgs.gov/2012/12/**>). Assessment of overwash deposits—material carried to the interior of the island—indicates that most of the sand lost from the beaches and dunes during Hurricane Sandy was moved offshore or down the coast. Field surveys conducted on a monthly to bimonthly basis to document recovery from Sandy are ongoing. As of December 2013, the beach and berm

(Fire Island Website continued on page 2)

Sound Waves

Editor
Helen Gibbons
Santa Cruz, California
Telephone: (831) 460-7418
E-mail: hgibbons@usgs.gov
Fax: (831) 427-4709

Print Layout Editors
Susan Mayfield, Sara Boore
Menlo Park, California
Telephone: (650) 329-5066
E-mail: smayfiel@usgs.gov; sboore@yahoo.com
Fax: (650) 329-5051

Web Layout Editor
Jolene Gittens
St. Petersburg, Florida
Telephone: (727) 502-8038
E-mail: jgittens@usgs.gov
Fax: (727) 502-8182

SOUND WAVES (WITH ADDITIONAL LINKS) IS AVAILABLE ONLINE AT URL
http://soundwaves.usgs.gov/

Contents

Submission Guidelines

Deadline: The deadline for news items and publication lists for the April/May issue of *Sound Waves* is Tuesday, March 25, 2014.
Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.
Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator© files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

U.S. Geological Survey
Earth Science Information Sources:

Need to find natural-science data or information? Visit the USGS Frequently Asked Questions (FAQ's) at URL **http://www.usgs.gov/faq/**

Can't find the answer to your question on the Web? Call **1-888-ASK-USGS**

Want to e-mail your question to the USGS? Send it to this address: **ask@usgs.gov**

(Fire Island Website continued from page 1)

have shown substantial recovery and are similar in elevation to the pre-storm beach.

This website is one of several planned products to connect people with USGS research related to Hurricane Sandy recovery, restoration, and rebuilding efforts, many of which are funded by Disaster Relief Appropriations Act 2013, also known as Sandy Supplemental (see <**http://soundwaves.usgs.gov/2013/12/research.html**>). (Read about two of those efforts in "Using Scenarios to Improve Resilience to Major Storms" <**http://soundwaves.usgs.gov/2014/02/spotlight.html**> and "USGS Deploys Oceanographic Gear Offshore of Fire Island, New York" <**http://soundwaves.usgs.gov/2014/02/spotlight3.html**>, this issue.)❁

Using Scenarios to Improve Resilience to Major Storms

By Kristin Ludwig

A new report from the U.S. Department of the Interior (DOI) Strategic Sciences Group (SSG) examines Hurricane Sandy's impacts on the New York/New Jersey region and suggests ways to improve resilience to future major storms. The *Operational Group Sandy Technical Progress Report*, posted at <**http://coastal.er.usgs.gov/hazard-events/sandy/pubs/sandy-tech-progress-report.html**>, documents the findings of a team of experts from government, academic institutions, and non-governmental organizations—Operational Group Sandy—who convened in March 2013.

The team was asked to develop scenarios for the impacts of Sandy and future major storms on the region's ecology, economy, and people. Each scenario describes a cascade of consequences set in motion by Sandy's impacts. Flood damage to buildings and property, for example, led to further effects such as creation of debris, displacement of households, exposure to hazardous materials, business closures, and high cleanup costs, to name just a few. The report projects consequences approximately 5 years into the future, when a hypothetical severe storm called "Hurricane 2018" is imagined to strike the New Jersey coast in mid-August 2018. The authors list potential interventions that could be taken during the next 5 years to ameliorate the effects of such large storms.

***Erika Svendsen**, research social scientist with the U.S. Forest Service and participant in Operational Group Sandy, discusses scenarios of Sandy's impacts with colleagues during the March 2013 deployment of the DOI Strategic Sciences Group (SSG). Photograph courtesy of SSG.*

The U.S. Department of the Interior (DOI) established the DOI Strategic Sciences Group (SSG) in 2012 to construct interdisciplinary science-based scenarios of environmental crises affecting Departmental resources. Co-led by the Science Advisor to the National Park Service Director and the USGS Associate Director for Natural Hazards, the SSG reports to the Science Advisor to the Secretary of the Interior and can only be activated by the Secretary.

Hurricane Sandy made U.S. landfall near Atlantic City, New Jersey, in October 2012 (**http://soundwaves.usgs.gov/2012/12/**), less than a year after DOI established the SSG to construct interdisciplinary science-based scenarios of environmental crises affecting

(Scenarios continued on page 3)

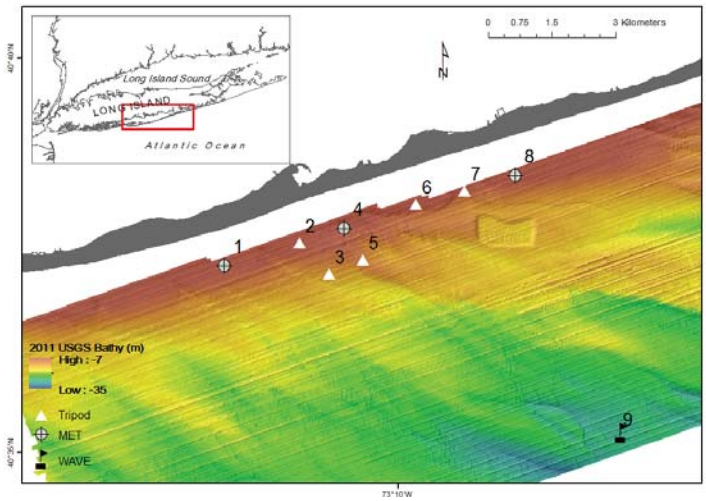
(Scenarios continued from page 2)

Departmental resources. In January 2013, the Secretary of the Interior directed the SSG to support the Department's participation in the Federal Hurricane Sandy Rebuilding Task Force. For this effort, the SSG assembled Operational Group Sandy, whose work is presented in the report. DOI used SSG findings to help inform the selection of projects to be supported by Hurricane Sandy supplemental funds (see **http://soundwaves.usgs.gov/2013/12/research.html**).

USGS Deploys Oceanographic Gear Offshore of Fire Island, New York

By John C. Warner, Jeffrey H. List, William C. Schwab, and Cheryl J. Hapke

The U.S. Geological Survey (USGS) Coastal Change Processes Project is conducting a field experiment on the inner continental shelf offshore of Fire Island, New York, to study the coastal response to storms. Starting in early February 2014, scientists from the USGS Woods Hole Coastal and Marine Science Center in Woods Hole, Massachusetts, along with scientists from the Woods Hole Oceanographic Institution and the University of South Carolina, deployed oceanographic equipment at nine sites in water depths of approximately 12 meters (40 feet), with one site farther offshore at a water depth of approximately 25 meters (80 feet) (see map).



*Locations of oceanographic equipment deployed from February to April 2014 offshore of Fire Island, New York. MET, meteorological station; WAVE, buoy that telemeters surface-wave data to the Coastal Data Information Program (CDIP, <**http://cdip.ucsd.edu/**>); m, meters. Color-coded high-resolution bathymetry from Schwab and others, <**http://dx.doi.org/10.2112/JCOASTRES-D-12-00160.1**>.*

The equipment consists mainly of tripods deployed on the seafloor that hold instruments to measure surface waves, ocean currents, water levels, salinity, and temperature. Several sites have additional equipment to measure near-bed turbulence, vertical profiles of suspended-sediment concentrations, and seafloor ripples. All of the sites are guarded with surface buoys to help protect the equipment. Several of the buoys have meteorological sensors to measure wind speed and direction, atmospheric pressure, air temperature, and solar heat fluxes. At the site located farthest offshore, a specialized buoy that measures surface waves will telemeter wave data back to the Coastal Data Information Program (CDIP) where it will be available online (<**http://cdip.ucsd.edu/**>). It is anticipated that local mariners, other Federal agencies, and recreational users will utilize the data in real time. This buoy is expected to remain on site for several years.

This effort is in part a response to assess the impacts and help determine the resiliency of coastal systems, such as Fire Island, to storm events such as Hurricane Sandy. The specific main focus of this deployment is to measure the distribution of waves along the coast with instruments at sites 1-2-4-6-7-8 and to measure the cross-shore variability of sediment fluxes at sites 2-3 and 4-5 (see map). This information will be used to assess the alongshore variability in coastal response to storms. It is anticipated that large-scale offshore bathymetric features (described in "Geologic evidence for onshore sediment transport from the inner continental shelf—Fire Island, New York," by **William C. Schwab** and others, 2013, <**http://dx.doi.org/10.2112/JCOASTRES-D-12-00160.1**>) modify the approaching waves and can alter the alongshore variability of sediment movement. Additionally, during the deployment, researchers from the USGS St. Petersburg Coastal and Marine Science Center in St. Petersburg, Florida, along with scientists from the U.S. Army Corps of Engineers, will map parts of the island dune, beach, and nearshore morphology using a vehicle-mounted lidar and radar system. This data will be part of a continued monitoring of the recovery of the system. The overall goal is to better understand the processes that cause coastal change and to develop models for forecasting coastal change.

*Instrument tripod to be deployed on the seafloor to measure waves, currents, near-bed turbulence, suspended-sediment concentrations, salinity, and temperature. USGS photograph by **Sandy Baldwin**.*

New Geologic Explanation for the Florida Middle Ground in the Gulf of Mexico

By Chris Reich and Helen Gibbons

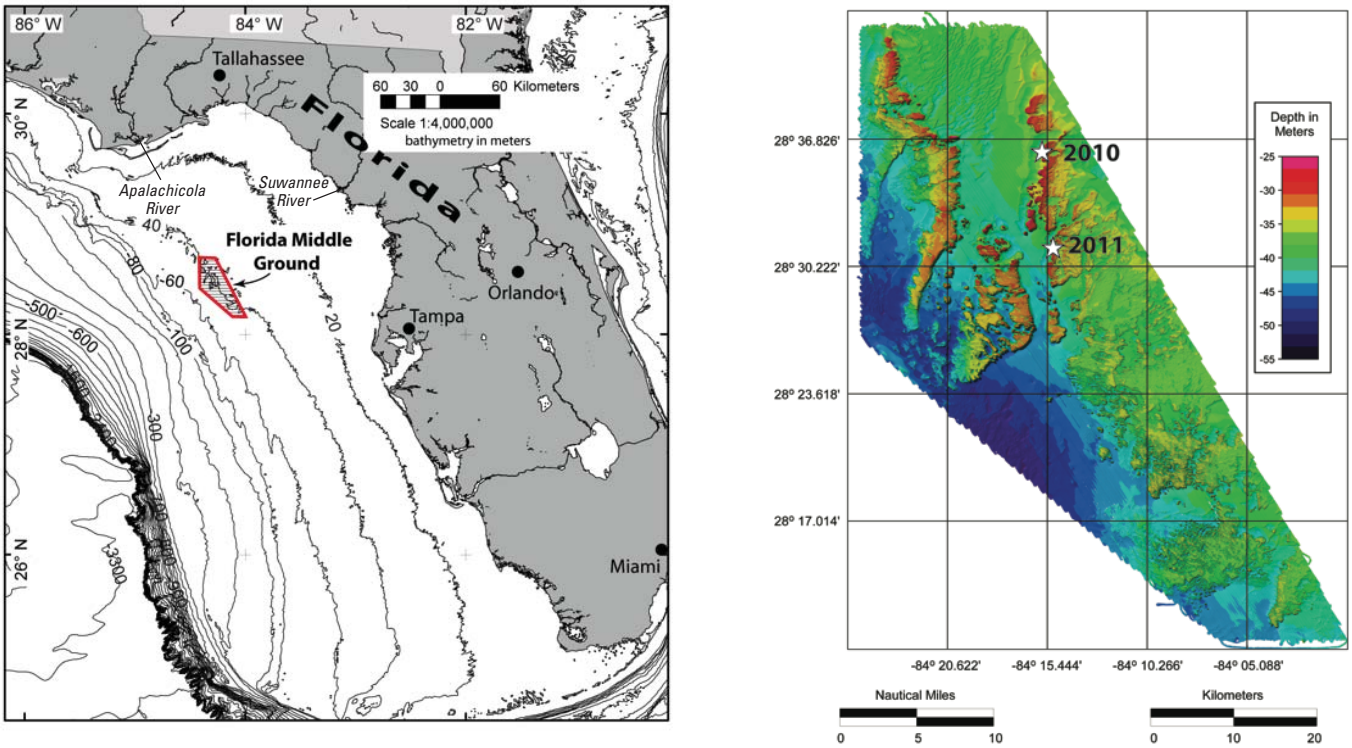
The Florida Middle Ground is a series of underwater ridges on the otherwise gently sloping continental shelf off the west coast of Florida. The origin of this anomalous feature has long intrigued scientists, who developed hypotheses based on the shapes of the ridges, samples of surface sediment, and images of subseafloor layers. In 2010 and 2011, U.S. Geological Survey (USGS) scientists drilled into some of the ridges and discovered evidence of an origin no one had yet proposed: the ridges likely formed as a series of shore-parallel sediment bars eventually capped and preserved by vermetid gastropods, or "worm snails." The results were reported in 2013 in the *Journal of Coastal Research* (<**http://dx.doi.org/10.2112/SI63-005.1**>).

The Florida Middle Ground covers an area of about 1,200 square kilometers (460 square miles) in the northeastern Gulf of Mexico, approximately 180 kilometers (110 miles) northwest of Tampa Bay. Running parallel to the shelf edge in a north-northwest direction, the ridges are as much as 60 kilometers (40 miles) long and 15 kilometers (10 miles) wide. Water depths range from about 25 meters (80 feet) on the ridge crests to more than 45 meters (150 feet) in the troughs. Individual banks have vertical relief of 10 to 15 meters (30 to 50 feet), about as high as 3- to 5-story buildings.

Near-vertical bank edges consisting of overhangs and caverns plus a supply of nutrients and warm tropical waters from the Loop Current have created environments rich in tropical and subtropical fish and invertebrate animals. The invertebrates include numerous coral species that give the Florida Middle Ground the distinction of being the northernmost living coral reef in the conterminous United States.

For more than a century, this unusual feature challenged those seeking to understand its origin. From its discovery in the late 1800s by fishermen from Tampa Bay and Apalachicola Bay, through the first reconnaissance survey in 1914 by the U.S. Coast and Geodetic Survey, to modern geophysical surveys, the dramatic bathymetric relief of the Florida Middle Ground inspired many hypotheses about its geologic composition and history. One of the first proposals, because of the shape and orientation of the ridges, was that the Florida Middle Ground was a drowned river valley, with the two main ridges being riverbanks that were drowned by rising seas and then cemented and lithified (turned into rock). The sediment that

(Florida Middle Ground continued on page 5)



Left, Location map of the Florida Middle Ground (FMG) in the northeastern Gulf of Mexico. Right, High-resolution multibeam bathymetric image of the FMG showing the linear north-south-trending ridges and dramatic vertical relief. Location of the two drilling sites, "2010" and "2011," are shown as stars. Multibeam image courtesy of ***David Naar****, University of South Florida.*

(Florida Middle Ground continued from page 4)

formed the riverbanks was thought to have come from either the Apalachicola or the Suwannee River about 10,000 years ago, when sea level was 40 meters (130 feet) lower than it is today. The most prevalent and persistent hypothesis was that the Florida Middle Ground was a buildup of coral reefs. The coral-reef hypothesis was first proposed in the early 1960s and survived until USGS scientists succeeded in collecting samples from inside the ridges.

In the spring of 2010, **Chris Reich**, **Don Hickey**, **Keith Ludwig**, and colleagues at the USGS St. Petersburg Coastal and Marine Science Center (SPCMSC) in St. Petersburg, Florida, took on the challenge of organizing a team of drillers and experienced scuba divers to be the first group to collect a "long" core from the Florida Middle Ground. Theirs would not be the first core—in a 1972 Master's thesis for Florida State University, **Robert M. Back** mentioned a 2.1-meter (6.9 foot) core collected by another researcher from an unknown location in the Florida Middle Ground and described simply as "carbonate rock." On the basis of this and other information available to them in 2010, the USGS scientists expected that the cores they planned to collect would confirm and add detail to the coral-reef hypothesis for the origin of the ridges.

Though the team members were highly experienced divers, many were novices when it came to drilling. Reich and Hickey tried to pair the experienced drillers with those that didn't have much or any background in drilling. The dive team consisted of **Lee Bodkin** (USGS, Texas Water Science Center, Shenandoah), **Kayla Gibbs** (USGS, Texas Water Science Center, Ft. Worth), **Don Hickey** (USGS SPCMSC), **Paul Knorr** (USGS SPCMSC), **Keith Ludwig** (USGS SPCMSC), **Justin McInnis** (USGS, Texas Water Science Center, Austin), **Chris Reich** (USGS SPCMSC), **BJ Reynolds** (USGS SPCMSC), **Jordan Sanford** (USGS SPCMSC), **Adam Brame** (National Oceanic and Atmospheric Administration's National Marine Fisheries Service, NOAA-NMFS), **Anastasio Stathakopoulos** (National Coral Reef Institute at Nova Southeastern University), and **Libby Carnahan** (Florida Sea Grant). **Marc Blouin** (USGS Bureau Dive Safety Program Manager) served as the dive safety officer (DSO). **Gene Shinn** (USGS, retired), **Al Hine** (University of South Florida [USF]), and **Stan Locker** (USF) were extremely helpful in identifying a coring site on the basis of previously collected high-resolution seismic profiles—images of subseafloor layers produced from acoustic (sound) data. Another factor in site selection was water depth; to avoid the need for decompression after their scuba dives, the team elected to spend no more than 45 minutes at depths of 86 feet or less.

The organizers chartered the merchant vessel (M/V) *Spree*, which became the team's living quarters and center for div-

(Florida Middle Ground continued on page 6)

Left, ***Kayla Gibbs*** *(left) and* ***Jordan Sanford*** *drilling into the vermetid caprock. White plume consists of tiny fragments of the material being drilled plus seawater being circulated as drilling fluid. The very fine mud quickly dissipates and does not harm the benthic community. Below,* ***Don Hickey*** *(left) unthreads the core catcher in preparation for removing the core sample from the inner barrel, while* ***Marc Blouin*** *enjoys the beautiful sea and weather conditions. Photographs by* ***Colm O'Reilly****, M/V* Spree.

Research vessel (R/V) Halimeda *anchored on the drilling site. The 2010 drilling operations were conducted from the* Halimeda*, which housed the hydraulic power-supply motors for the drill and water pump. Note the beautiful sea conditions, which persisted throughout the week. Photograph by* ***Colm O'Reilly****, M/V* Spree.

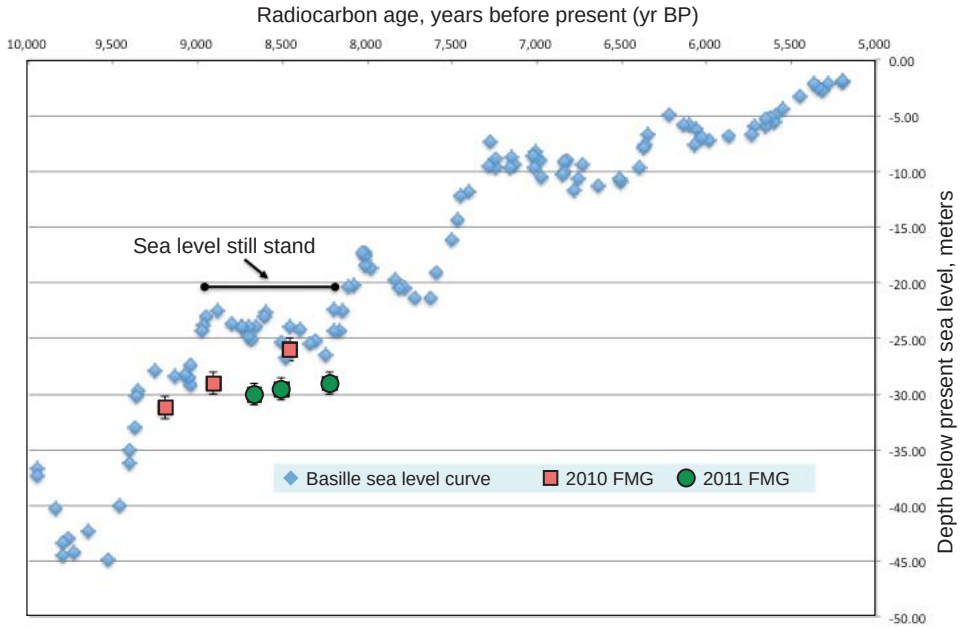
(Florida Middle Ground continued from page 5)

ing operations. They towed the USGS research vessel (R/V) *Halimeda* for use as the drilling platform. The first round of coring took place from August 1 to 7, 2010, at a water depth of 26 meters (86 feet). The seas were calm for the entirety of the coring operations, which the team members more than welcomed and to which they give partial credit for the trip's success. In order to verify that their findings were not unique to the northern part of the ridge drilled in 2010, six of the scientists made a separate drilling trip on the USGS R/V *Gilbert* in September 2011 and took a single 0.6-meter (2 foot)-long core. The September 2011 core was collected approximately 10 kilometers (6 miles) south of the 2010 coring site in approximately 29 meters (95 feet) of water.

The 2010 core samples were collected with the USGS rotary hydraulic corer, a versatile tool developed decades ago by the USGS (for example, see photographs in "Passing the Torch...," *Sound Waves*, November/December 2013, <**http://soundwaves.usgs.gov/2013/12/staff.html**>). The corer uses a wireline system, a high-speed/low-torque hydraulic motor, and a gear pump that circulates seawater as drilling fluid. The wireline system contains an inner barrel that retains a 2-inch-diameter core, which is extracted at 5-foot intervals. Once extracted, the barrel and core were sent up to the R/V *Halimeda*, where the core was removed from the barrel, placed in a box, and cataloged. Collectively, over the 5 days of diving and coring, the team logged 65 dives with a total bottom time of 101 hours. They drilled four holes that ranged in depth from 0.6 to 17 meters (2 feet to 57 feet) below the seafloor. Core recovery was very poor (0 to 20 percent) in all four holes, but the team collected enough material to complete a suite of analyses and make several definitive conclusions regarding the geologic history of the Florida Middle Ground.

So what did the scientists find? One thing they didn't find in any of the recovered material was remnants of coral. The Florida Middle Ground was not a coral reef buildup as many had previously presumed it to be. Nor was it a drowned river valley. The scientists were all a bit dumbfounded to discover that the ridges consisted of unconsolidated marine calcareous muddy sand, about 12 meters (40 feet) thick, overlying a weathered, fossiliferous limestone of Miocene age (between 5 and 22 million years old) and capped by a carbonate rock composed primarily of the sessile vermetid gastropod *Petaloconchus* sp. (a marine snail that cements its tubular shell to a hard surface, such as a rock or another shell; see photograph). Their observations suggest that the Florida Middle Ground is the remnant of a series of shore-parallel bars that formed as sea level was rising in the early Holocene, approximately 10,000 years ago. Subsequently the bars were capped by a 3.6-meter (12 foot)-thick unit of vermetid gastropods. Accelerator mass spectrometry radiocarbon ages (uncalibrated) on the vermetid cap rock indicate that it developed during a sea-level stillstand in the early Holocene, about 9,000 to 8,200 years ago. The still-

(Florida Middle Ground continued on page 7)



*Sea-level curve for the Gulf of Mexico (blue diamonds), with the time interval of the sea-level stillstand noted, centered at approximately 8,500 radiocarbon years before present (yr BP). ("Radiocarbon" refers to the use of radioactive carbon-14 to date organic materials; "present" is set at January 1, 1950, about the time that radiocarbon dating became practical.) Radiocarbon age dates for the vermetid rock are shown, with red squares for samples from 2010 and green circles for samples from 2011. Sea-level curve (blue diamonds) is from Balsillie and Donoghue, 2004, Florida Geological Survey Report of Investigations no. 103, 65 p. [**http://publicfiles.dep.state.fl.us/FGS/FGS%5FPublications/RI/RI103SeaLevelHistory.pdf** (1.2 MB)].*

*Close-up photograph of the vermetid core collected in 2011. Note the tight coiling of the vermetids' shells. Photograph is approximately 4 inches across. USGS photograph by **Chris Reich**.*

(Florida Middle Ground continued from page 6)

stand lasted nearly 1,000 years, providing ideal growing conditions for the vermetid gastropods. Waters during this period were shallow and had enough turbidity to provide material for binding the shells together, resulting in the development of a thick layer of vermetid shells. When sea-level rise accelerated, starting about 8,200 years ago, the vermetids could not adapt to the quickly changing environmental conditions and died.

Although the scientists now know that the ridges are armored with a vermetid gastropod cap rock, uncertainty remains regarding how and when the underlying, thick sequence of muddy sand was deposited. The drilling fluids excluded any of the sediment beneath the vermetid cap rock from being recovered in the inner barrel, but fortunately the divers were able to obtain some of this material in a short (approximately 20-centimeter [8 inch]-long) push core, collected by pushing a tube into the sediment. Where did all of the mud and sand come from, and are the researchers' assumptions about its depositional history correct? The only way to test this theory is to make a return visit to sample the entire sediment sequence with push cores or vibracores (long cores collected by vibrating a core barrel into the sediment; see video at <**http://gallery.usgs.gov/videos/534**>).

The complete citation for the article about this research is: Reich, C.D., Poore, R.Z., and Hickey, T.D., 2013, The role of vermetid gastropods in the development of the Florida Middle Ground, northeast Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 46–57, doi:10.2112/SI63-005.1 [**http://dx.doi.org/10.2112/SI63-005.1**].

Deep-Sea Corals Record Human Impact on Watershed Quality in the Mississippi River Basin

By Nancy Prouty and Helen Gibbons

Over the past 200 years, the Mississippi River watershed has seen the onset of industrialized agriculture and undergone intense land-use changes—a few examples include widespread plowing, drainage, irrigation, and fertilizer use. Related changes have occurred downstream, in shorelines, ecosystems, and coastal waters in the Gulf of Mexico. For example, the Mississippi carries excess nutrients, such as nitrogen and phosphorus, into the Gulf of Mexico, fueling algal blooms that deplete dissolved oxygen in coastal waters, producing a low-oxygen, or "hypoxic," zone every summer off the coast of Louisiana and Texas. The hypoxic zone—commonly called the "dead zone" because it stresses or kills organisms that cannot move out of it—is a heavily studied phenomenon (for example, see <**http://www.usgs.gov/blogs/features/usgs_top_story/dead-zone-the-source-of-the-gulf-of-mexicos-hypoxia/**>) whose upstream influences are closely monitored (for example, see "Nitrate Levels Continue to Increase in Mississippi River; Signs of Progress in the Illinois River," this issue, <**http://soundwaves.usgs.gov/2014/02/research3.html**>). In contrast, little information has been available until now about whether land-use changes upstream affect the whole-scale biology and chemistry of the Gulf of Mexico, including the deep sea and its ecosystems.

Black coral brought from a water depth of 317 meters (1,040 feet) on Viosca Knoll in the Gulf of Mexico to the deck of the research vessel (R/V) Seward Johnson *by scientists in the manned submersible* Johnson-Sea-Link II. *Coral skeleton is black; tissue is orange. USGS photograph (taken from inside the submersible) by* ***Christina Kellogg****.*

New research by the U.S. Geological Survey (USGS) shows that upstream land-use changes do affect deep waters of the Gulf of Mexico, as evidenced by the chemistry of long-lived deep-sea corals whose skeletons incorporate material from the surrounding water as the corals grow. Analyses of these coral skeletons (analogous to tree-ring studies) reveal a history of land-use change and provide baseline information that can assist efforts to improve water quality in the Mississippi watershed and the Gulf of Mexico.

The new research was reported in the journal *Global Biogeochemical Cycles* (<**http://dx.doi.org/10.1002/2013GB004754**>). To conduct the study, USGS oceanographer **Nancy Prouty** teamed up with national and international colleagues to analyze a suite of chemical components in deep-sea black corals. These corals build their skeletons of protein and chitin (the material in crustacean and insect shells) rather than the more familiar calcium carbonate ($CaCO_3$) of most shallow-water corals. Prouty and her coauthors performed numerous chemical analyses on layers of coral skeleton dated in an earlier study (see "Long-Lived, Slow-Growing Corals in Deep Waters of the Gulf of Mexico," *Sound Waves*, March 2011, <**http://soundwaves.usgs.gov/2011/03/research2.html**>) which showed that some of the black corals live for at least two millennia. The earlier study also confirmed that black corals make their skeletons mainly from particulate organic

(Deep-Sea Coral Record continued on page 8)

(Deep-Sea Coral Record continued from page 7)

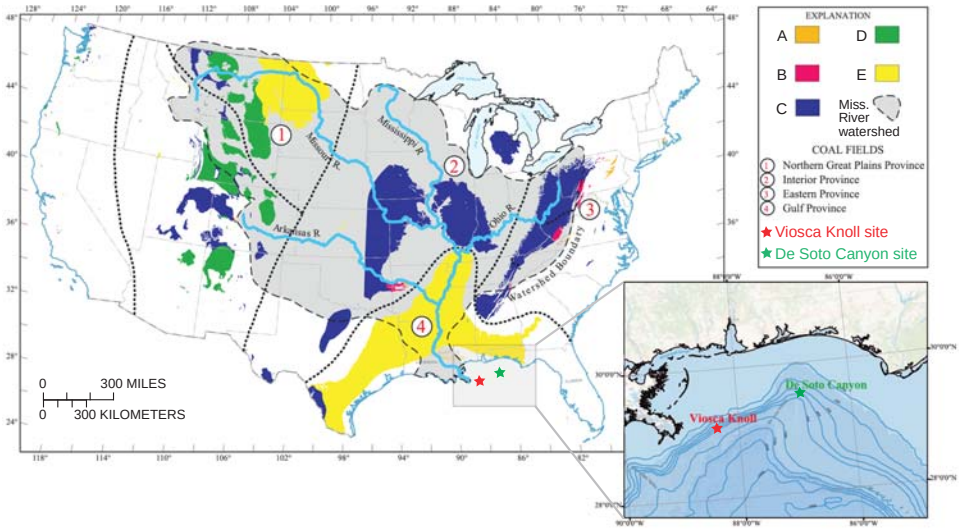
matter that sinks from the ocean surface. Thus, black corals can capture and record in their skeletons the history of changing constituents in surface waters, including elements delivered to the Gulf of Mexico from the Mississippi River Basin.

The authors introduced a new tracer of agro-industrialization: the trace metal rhenium (Re), which is believed to be released by coal burning and smelter emissions as well as by erosion of organic-rich sediment. They combined Re analyses with nitrogen isotope analyses to produce an extremely sensitive new toolset for understanding how agro-industrialization and land-use changes directly affect ocean biogeochemical cycles.

"Our coupled analysis of trace metals and bulk and compound-specific nitrogen isotopes in corals from the Gulf of Mexico capture the rapid sensitivity of deep-sea corals to upstream changes in watershed quality," explains Prouty. "These records provide not only a temporal perspective over the past one or two millennia, but also a quantitative context to evaluate the effects of future and ongoing land-use and climate change on nutrient loading and downstream biogeochemical cycles."

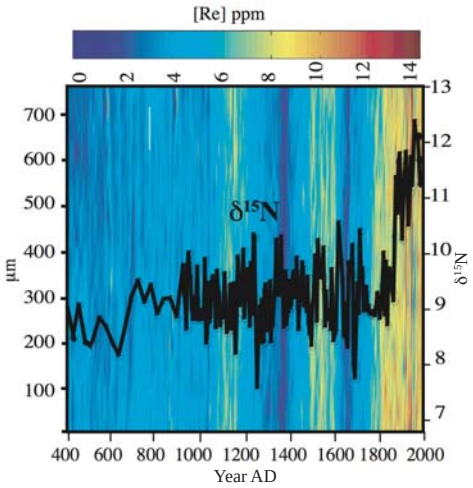
In progressively younger layers of the deep-sea corals' proteinaceous skeletons, the researchers discovered increasing levels of both Re and bulk nitrogen isotope ($\delta^{15}N$) values. By analyzing compound-specific nitrogen isotopes in amino acids from the coral skeletons, the authors were able to conclude that the $\delta^{15}N$ increase was due to a change in source nutrients, such as nitrate, rather than other causes, such as a change in the structure of the food web. The enrichment in both nutrients and Re was particularly strong over the last 150 to 200 years.

"Rhenium concentrations in major rivers worldwide suggest that the enrichment is largely due to human activity, but no pre-anthropogenic measurements of Re exist to validate this observation," said Prouty. "With our coral analyses, we have the first-ever record of pre-industrial Re variability—allowing us to quantify the anthropogenic contribution of Re in the Mississippi River and to the Gulf of Mexico: about 30 percent."



*Deep-sea coral samples (*Leiopathes *sp.) for this study were collected between 2003 and 2009 from the head of De Soto Canyon and Viosca Knoll at water depths of approximately 300 meters (1,000 feet) (see inset). The four major coal-producing areas are shown in relation to areal extent of Mississippi River watershed (gray with dashed outline). Colors indicate main types of coal present: A, anthracite, semi-anthracite, and meta-anthracite; B, low-volatile bituminous coal; C, medium- and high-volatile bituminous coal; D, sub-bituminous coal; E, lignite.*

Rhenium may seem like an obscure element, but naturally derived Re comes from the same source as naturally derived organic carbon—the erosion of organic-rich sediment. Because of this link, the authors were able to use the coral Re data to make estimates of organic carbon released by erosion in the watershed and compare those to estimates made by other researchers using other techniques (for example, isotopic composition of dissolved inorganic carbon).



Color-coded map of rhenium (Re) concentration in coral specimen's microstructure, with bulk nitrogen isotope ($\delta^{15}N$) measurements superimposed. Note increase in both Re and $\delta^{15}N$ starting about 150 to 200 years ago.

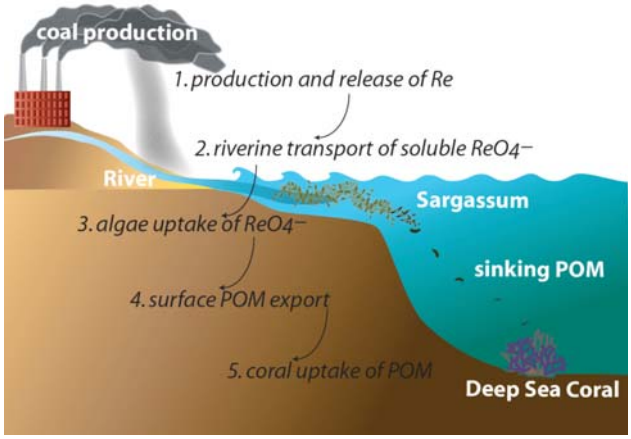
"I love this work because it feels so much like a detective story," said Prouty. "We spend a lot of time checking the evidence, following multiple leads, ruling out suspects, comparing findings from different lines of inquiry. And it's gratifying to achieve results that not only advance our knowledge but can also be used to restore watersheds and coastal ecosystems."

One group likely to benefit from the new work is the multiagency Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force (<**http://water.epa.gov/type/watersheds/named/msbasin/**>), established in 1997 to reduce and control hypoxia in the Gulf. Conservation goals of the Hypoxia Task Force include reduction in fertilizer use, nitrate transport, and contaminants through modifying agricultural practices. Without baseline information, however, these targets remain elusive. Results from the novel suite of tracers developed by Prouty and her coauthors provide critical—and until now unavailable—baseline information about trace metals and nutrients. Ultimately, this information can assist efforts to reduce future fertilizer use and nitrate transport and enhance watershed restoration.

(Deep-Sea Coral Record continued on page 9)

(Deep-Sea Coral Record continued from page 8)

Nancy Prouty is a research oceanographer at the USGS Pacific Coastal and Marine Science Center in Santa Cruz, California, where she focuses on projects to enhance understanding of climate variability on human-relevant timescales and the impact of human activities on climate. She is involved in both shallow coral studies with the Pacific Coral Reefs Project (<**http://coralreefs.wr.usgs.gov/**>) and deep-sea coral studies with the Diversity, Systematics and Connectivity of Vulnerable Reef Ecosystems (DISCOVRE) team (<**http://fl.biology.usgs.gov/DISCOVRE/**>). She is part of a multiagency team that received a U.S. Department of the Interior 2013 Partners in Conservation Award for its investigation of the ecology of deepwater canyons off the U.S. mid-Atlantic coast (see "USGS Among Recipients of Prestigious DOI Partners in Conservation Award," this issue, <**http://soundwaves.usgs.gov/2014/02/awards.html**> and "Deepwater Canyons 2013: Pathways to the Abyss, <**http://oceanexplorer.noaa.gov/explorations/13midatlantic/welcome.html**>).



Conceptual model of source, transport, and sink of anthropogenically derived rhenium (Re). 1, Production of Re from coal burning and smelter emissions. 2, Riverine transport of soluble Re (perrhenate, ReO_4^-). 3, Uptake and concentration of Re by algae. 4, Degradation of algae and sinking of Re as particulate organic matter (POM). 5, Deep-sea coral uptake of POM as dominant food source, resulting in preservation of anthropogenic Re in deep-sea coral skeleton. USGS illustration by ***Laura Torresan****.*

The full citation for the new article is:

Prouty, N.G., Roark, E.B., Koenig, A.E., Demopoulos, A.W.J., Batista, F.C., Kocar, B.D., Selby, D., McCarthy, M.D., and Mienis, F., 2014, Deep-sea coral record of human impact on watershed quality in the Mississippi River Basin: Global Biogeochemical Cycles, published online January 24, 2014, doi:10.1002/2013GB004754 [**http://dx.doi.org/10.1002/2013GB004754**].

Nitrate Levels Continue to Increase in the Mississippi River; Signs of Progress in the Illinois River

By Michael Woodside and Lori Sprague

Nitrate levels in the Illinois River decreased by 21 percent between 2000 and 2010, marking the first time substantial, multiyear decreases in nitrate have been observed in the Mississippi River Basin since 1980, according to a U.S. Geological Survey (USGS) study published in October 2013 (<**http://pubs.usgs.gov/sir/2013/5169/**>).

Unfortunately, similar signs of progress were not widespread. "Nitrate levels continue to increase in the Missouri and Mississippi Rivers, including the Mississippi's outlet to the Gulf of Mexico," said **Lori Sprague**, USGS research hydrologist and coauthor of the October 2013 report.

Excessive nitrate and other nutrients from the Mississippi River strongly influence the extent and severity of the hypoxic zone that forms in the northern Gulf of Mexico every summer. This hypoxic zone, known as the "dead zone," is characterized by extremely low oxygen

(Nitrate Levels continued on page 10)

USGS personnel collecting a water-quality sample at the Missouri River at Hermann, Missouri, in July 2011. USGS photograph by ***Kelly Brady****.*

(Nitrate Levels continued from page 9)

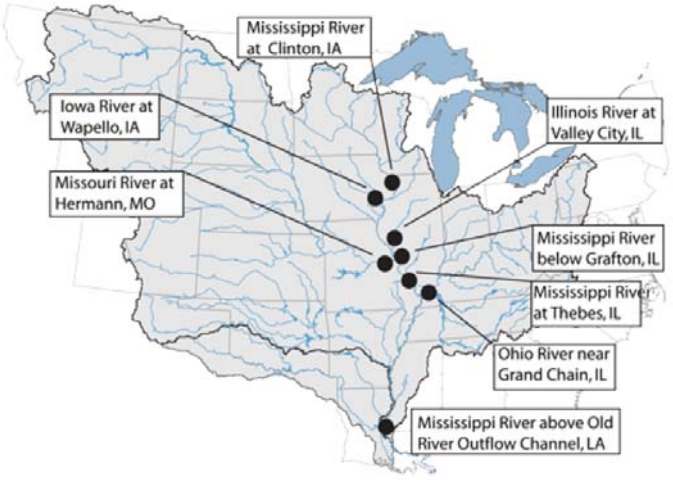
levels in bottom or near-bottom waters, degraded water quality, and impaired marine life. Dead zones occur in many areas (for example, see "A Research Cruise to Investigate Natural Versus Human Impacts on Marine Ecosystems in Hood Canal, Washington," *Sound Waves*, November/December 2013, <**http://soundwaves.usgs.gov/2013/12/fieldwork3.html**>), but the Gulf hypoxic zone is the largest in the United States. In 2013 it encompassed 5,840 square miles, an area the size of Connecticut.

"The USGS results show that solving the problem of the dead zone will not be easy or quick. We will need to work together with our Federal and State partners to develop strategies to address nitrate concentrations in both groundwater and surface water," said **Lori Caramanian**, Department of the Interior Deputy Assistant Secretary for Water and Science.

"Expanded research and monitoring are absolutely essential to tracking progress in reducing nutrient pollution in the Mississippi River Basin," said **Nancy Stoner**, acting Assistant Administrator for Water at the U.S. Environmental Protection Agency and co-chair of the Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force (<**http://water.epa.gov/type/watersheds/named/msbasin/**>). "The Federal agencies and States that are part of the Hypoxia Task Force greatly appreciate this work by USGS and how it advances the science in the Mississippi River Basin."

The reasons for increases or declines in annual nitrate levels are unknown. Reliable information on trends in contributing factors, such as fertilizer use, livestock waste, agricultural-management practices, and wastewater-treatment improvements, is needed to better understand what is causing increases or decreases in nitrate.

Nitrate trends from 1980 to 2010 were determined at eight long-term USGS monitoring sites in the Mississippi River Basin—including four major tributaries (Iowa, Illinois, Ohio, and Missouri rivers) and four locations along the Mississippi River—using methodology that adjusts for year-to-year variability in streamflow conditions (see map).



*Mississippi River drainage in the central United States, showing locations of the eight permanent nitrate-monitoring stations (black dots). From <**http://water.usgs.gov/nawqa/pubs/nitrate_trends/**>.*

Key Trends in Nitrate Concentration at Long-Term USGS Monitoring Sites

*(From "Nitrate in the Mississippi River and its tributaries from 1980 to 2010: Are we making progress?" <**http://water.usgs.gov/nawqa/pubs/nitrate_trends/**>)*

- Nitrate concentrations steadily decreased by 21 percent in the Illinois River from 2000 to 2010. Decreases were also noted in the Iowa River during this time, but the declines were not as large (10 percent).
- Consistent increases in nitrate concentrations occurred between 2000 and 2010 in the upper Mississippi River (29 percent) and the Missouri River (43 percent).
- Nitrate concentrations in the Ohio River are the lowest among the eight Mississippi River Basin sites and have remained relatively stable over the past 30 years.
- Nitrate concentrations increased at the Mississippi River outlet by 12 percent between 2000 and 2010.
- Nitrate increased at low streamflows throughout the basin, except for the Ohio and Illinois Rivers. Groundwater is likely the dominant source of nitrate during low flows. It may take decades for nitrate to move from the land where it was applied, migrate through groundwater, and eventually flow into these rivers. Because of this lag time, several years or decades can elapse before the full water-quality effects of either increased groundwater contamination or improved management practices are evident in the rivers.

The USGS report and additional information on nitrate trends in concentration and flux for each of the eight sites are available at <**http://water.usgs.gov/nawqa/pubs/nitrate_trends/**>. More information about USGS long-term monitoring sites in the Mississippi River Basin is available at the USGS National Water-Quality Assessment (NAWQA) program's website, <**http://water.usgs.gov/nawqa/**>.

Related USGS Nitrate News

The USGS recently began using optical sensors in the Mississippi River Basin to track the movement and quantity of nitrate delivered from small streams all the way to the Gulf of Mexico in real time (see USGS news release at <**http://www.usgs.gov/newsroom/article.asp?ID=3668**>). Optical data collected every 15 minutes to 3 hours at the mouth of the Mississippi and on several major tributaries will complement the long-term monitoring described above, providing researchers with new insights into the storage and transport of nitrate and improving agencies' ability to measure the effectiveness of management actions.

At the other end of the spectrum, new research by USGS coastal and marine scientists shows that chemical analyses of long-lived deep-sea corals can provide information about the movement of nitrogen and other elements from the Mississippi River Basin into the Gulf of Mexico over timescales stretching back hundreds to thousands of years (see "Deep-Corals Record Human Impact on Watershed Quality in the Mississippi River Basin," this issue, <**http://soundwaves.usgs.gov/2014/02/research2.html**>).

USGS Scientist Examines Foraminifera Collected from Remote Clipperton Island

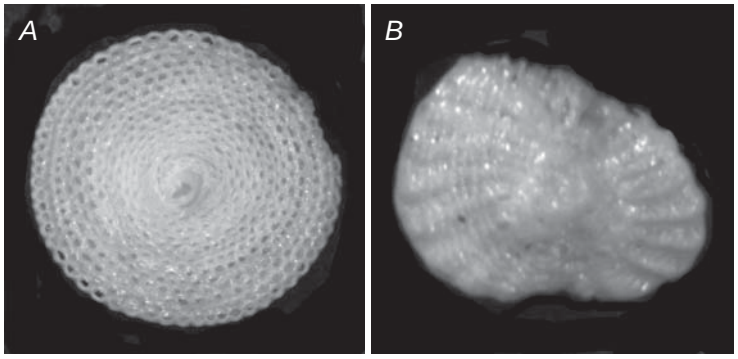
By Mary McGann and Helen Gibbons

Clipperton Island is an uninhabited French island in the Pacific Ocean, approximately 1,300 kilometers (800 miles) from the Central American mainland. Abyssal ocean depths lie between Clipperton Island, the mainland, and the other four island groups of the tropical eastern Pacific Ocean (the Revillagigedo Islands of Mexico, Cocos Island of Costa Rica, Malpelo Island of Colombia, and the Galápagos Islands of Ecuador). Clipperton Island's remoteness attracts DXers—amateur ("ham") radio operators seeking to achieve radio communications over long distances and in exotic locales. ("DX" comes from an abbreviation for "distance" used by Morse code operators.) It also attracts biologists interested in the nature, origin, and distribution of its organisms.

In February–March 2013, the 2013 Cordell Expedition (TX5K) to Clipperton Island (<**http://www.cordell.org/CI/**>) combined ham radio operations with science. While most of the group exchanged radio communications with ham operators around the world, other expedition members made wildlife observations and collected samples of sand from around the island. After the expedition, the sand samples were transferred to **Mary McGann**, a micropaleontologist with the U.S. Geological Survey (USGS), who examined them for microscopic one-celled organisms called foraminifera.

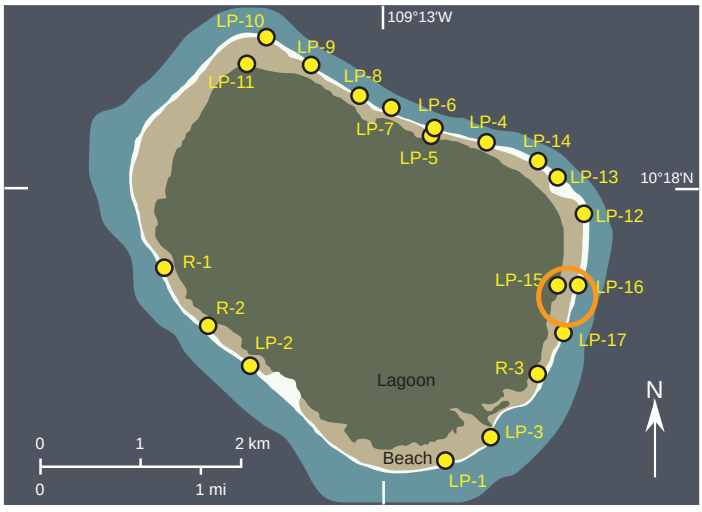
The summary of a 1958 scientific expedition to Clipperton Island (<**http://scilib.ucsd.edu/sio/hist/SIOreference59-13.pdf**>, 1.6 MB) mentions collecting foraminifera and states that they would be housed at the University of California Museum of Paleontology in Berkeley, but those collections could not be found in 2013. McGann's study, therefore, is the first detailed examination of foraminifera from the island. It was prompted by some of the scientific questions raised by Clipperton Island's isolation:

- Does the island host organisms from both the tropical eastern Pacific Ocean along the Pacific coast of the Americas (the Panamic Province) as well as tropical waters from the Indian Ocean and the western and central Pacific Ocean (the Indo-Pacific Province)?
- How do these organisms disperse to Clipperton Island?
- How large a role do endemic organisms—those that live only in the immediate area of Clipperton Island or the islands nearby—play in local ecosystems?



Foraminifera from Clipperton Island. A, Sorites *sp., 1.2 millimeters in diameter. B,* Pseudohauerina orientalis*, 0.3 millimeters high by 0.4 millimeters wide. USGS photographs by* ***Mary McGann****.*

Location of Clipperton Island and other islands in the tropical eastern Pacific Ocean.



Map of Clipperton Island, showing site of 2013 Cordell Expedition (TX5K) camp (orange circle) and locations of sand samples collected for analysis of foraminifera (yellow dots). LP, samples collected by ***Louis-Philippe Loncke****; R, samples collected by* ***Robert W. Schmieder****; km, kilometers; mi, miles.*

(Clipperton Island continued on page 12)

(Clipperton Island continued from page 11)

Clipperton Island is the only atoll (ring-shaped coral reef encircling a lagoon) in the tropical eastern Pacific Ocean. Most tropical islands have many habitats where organisms can live—such as muddy, silty, and sandy bottoms; rocky shorelines; and extensive plant life near the water, including mangrove forests and algal mats. These habitats are lacking on Clipperton Island. Instead, coral covers extensive areas, making biodiversity far lower than for most tropical islands.

Because of Clipperton Island's unique environmental conditions, one goal of the 2013 Cordell Expedition was to document the distribution of an element of the island's biota: foraminifera, organisms about the size of a sand grain that produce a hard shell and are abundant in brackish to marine waters. These tiny animals are of particular interest to scientists because they are extremely sensitive to climate change and environmental pollution. To sample the island's foraminifera, expedition member **Louis-Philippe Loncke**, with some help from expedition leader **Robert Schmieder**, collected beach sand from 17 sites in the surf zone around the perimeter of the island and three sites on the margin of the inner brackish-water lagoon. This is the first known detailed collection of these organisms in the vicinity of Clipperton Island.

As expected, McGann's preliminary observations show that the diversity of foraminifera is extremely low on Clipperton Island. Whereas hundreds of species are typically found on tropical Pacific islands, the samples from Clipperton Island contain only 21 species representing 11 genera: *Sorites*, *Quinqueloculina*, *Spirillina*, *Peneroplis*, *Pseudohauerina*, *Elphidium*, *Massilina*, *Cibicides*, *Planorbulina*, *Rectobolivina*, and *Globigerinoides*. The low diversity may result from several factors, including the scarcity of habitats where these tiny organisms can live, difficulty finding food, and a pounding surf that smashes shells and other biological remains deposited in the surf zone and along the beach. No endemic foraminifera were discovered, but foraminifera from both the tropical eastern Pacific Ocean and the Indo-Pacific region were observed. How these foraminifera reach the island is a topic for further investigation.

*TX5K campsite on an open, flat sand deposit in front of a palm grove, with lagoon in background. Photograph courtesy of **Robert W. Schmieder**, Cordell Expeditions, 2013 Expedition to Clipperton Island (<**http://www.cordell.org/CI/**>).*

In addition to the tiny foraminifera, remains of other organisms were found in the sand samples. The surf and beach samples included tiny clams, bryozoans (minute colonial filter feeders also known as "moss animals"), crab claws, sea urchin spines, snails, worm tubes, and ostracods (tiny crustaceans sometimes called "seed shrimp"). Samples from the inner lagoon contained fish bones and teeth, clams, snails, ostracods, insects, and seeds of aquatic plants.

Currently, the sand samples are being analyzed more thoroughly in an effort to find other foraminiferal species. McGann is also attempting to obtain fine sediment collected offshore by benthic grabs and scuba dives during a 2007 expedition to Clipperton Island to study molluscs—a diverse group that includes snails, octopuses, clams, squid, and oysters. (The 2007 expedition is described by **Kirstie L. Kaiser** in "The recent molluscan fauna of Île Clipperton…,"published September 9, 2007, in volume 39 of *The Festivus*, <**http://www.stri.si.edu/sites/publications/PDFs/Ile_Clipperton_COMPLETE2.pdf**>, 20.6 MB.) McGann hopes to discover a more pristine and diverse foraminiferal fauna in the offshore samples.

To learn more about the 2013 expedition, visit the Cordell Expedition website at <**http://www.cordell.org/CI/**>.❁

*Aerial photograph of TX5K camp. Photograph courtesy of **Robert W. Schmieder**, Cordell Expeditions, 2013 Expedition to Clipperton Island (<**http://www.cordell.org/CI/**>).*

USGS Plays Leadership Role in 3rd Annual St. Petersburg (Florida) Science Festival, Adding Sneak Peek School Day and Mentoring New Science Festival Initiatives

By Theresa Burress

The 3rd Annual St. Petersburg Science Festival, October 18–19, 2013, underwent its third straight year of expansion with the debut of an exclusive Sneak Peek for Schools. Led by U.S. Geological Survey (USGS) oceanographer **Kara Doran**, the school-day event on Friday was a preview of the public festival on Saturday. The Sneak Peak offered 30 interactive science activities to 1,250 teachers and students in grades 4–8.

"The first Sneak Peek day for schools was a great opportunity to expose students from the Tampa Bay region to the science happening in their own backyards. The exhibits engaged students in hands-on science activities that tied in to what they learn in science class, helping them to make the connection between classroom and the real-world," said Doran, who studies the impacts of hurricanes on beaches and barrier islands at the USGS St. Petersburg Coastal and Marine Science Center (<**http://coastal.er.usgs.gov/**>).

Co-chaired by **Theresa Burress**, Cherokee Nation Technology Solutions (CNTS) contractor to USGS, and **E. Howard Rutherford**, development director of the University of South Florida (USF) College of Marine Science (<**http://www.marine.usf.edu/**>), the St. Petersburg Science Festival organized several events culminating in the public festival on Saturday, which offered more than 100 science, technology, engineering, and math (STEM) activities ranging from crazy chemistry experiments to fighting robot competitions. Visitors had the opportunity to board a research vessel, build a fire, run an underwater remotely operated vehicle (ROV), peer into a microscope at microfossils and archaeological artifacts, test an artificial limb, launch a rocket, and more. A record-breaking 17,500 visitors attended Saturday's free event, which was held on the St. Petersburg campus of USF and neighboring Poynter Park.

The school-day expansion was possible in part due to a 2-year grant awarded to the St. Petersburg Science Festival in exchange for serving as a model and mentor for three new science-festival initiatives in the southeastern U.S. The St. Petersburg festival co-chairs are working closely with the festival coordinators who are bringing these new festivals to fruition in 2014: **Laura Diedrick**, an education specialist at the Smithsonian Marine Station/CO-SEE Florida (<**http://www.coseeflorida.org/**>) and Indian River Lagoon Science Festival coordinator; **Michael Hemphill**, director of development and marketing for the Science Museum of Western Virginia (<**http://www.smwv.org/**>); and, from The Citadel, **Glenda La Rue**, director of their STEM Center of Excellence, and Dean **Lok Lew Yan Voon** and Assistant Dean for Development **Krystal Oliveira** of the School of Science and Mathematics. As part of the mentoring project, most of them participated in the St. Petersburg Science Festival: Diedrick as an exhibitor; and Hemphill, Lew Yan Voon, and Oliveira as tour guides during the Sneak Peek for Schools and as members of Saturday's evaluation team.

***Caitlin Reynolds** (USGS), upper right, assists a young festival attendee in viewing foraminifera shells under a microscope. Photograph by **Catherine Hayslip**, NOAA.*

The 2-year mentoring project is one of the Science Festival Alliance (<**http://www.sciencefestivals.org/**>) projects funded by the Alfred P. Sloan Foundation's Public Understanding of Science and Technology program and administered by the Massachusetts Institute of Technology (MIT) Museum offices of the Cambridge Science Festival.

"With the funding from the Sloan Foundation, the Science Festival Alliance is happy to provide a financial reward for St. Petersburg and the other three lead festivals for putting the time into supporting new initiatives. Our goal is to continue to add to the number of festivals operating in diverse communities, and to have those festivals be networked together, until we have reached a critical mass of festival activity throughout the country such that the festival format is proven to work in many different situations. More than anything, it is a chance to show people how science is involved in their lives, and to inspire," said **Ben Wiehe**, manager of the Science Festival Alliance.

The USGS St. Petersburg Coastal and Marine Science Center, which has participated as a lead collaborator and exhibitor since the festival's inception in 2011 (see "USGS is Valuable Partner in First St. Petersburg, Florida, Science Festival," *Sound Waves*, August 2011 <**http://soundwaves.usgs.gov/2011/08/outreach.html**>), contributed five exhibits in support of Saturday's event. USGS geologists **Caitlin Reynolds**, **Katie Richwine**, and **Chris Reich** paired with chemist **Jen Flannery** and student intern **Kelsey Roberts** to offer joint exhibits highlighting the diverse climate investigations at the science center. "Catch Climate Fever" taught visitors to distinguish different species of foraminifera, microscopic marine organisms whose shell chemistry is used to help determine sea temperatures in the Gulf of Mexico over the course of thousands of years. "Climate Change and Coral Reefs" offered a perspective on how changing climates can affect reef health and growth, and also how coral reef skeletons can be used to create detailed sea-temperature records over the last hundred or more

(Science Festival continued on page 14)

(Science Festival continued from page 13)

years. Research oceanographers **P. Soupy Dalyander**, **Kara Doran**, and **Joe Long** emphasized the impacts of hurricanes and extreme storms along our coastline with an engaging, interactive physical model of coastal erosion. USGS Mendenhall Research Fellow **Sophia Liu** gave visitors the opportunity to contribute their scientific interpretation of hurricane impacts through analysis of paired pre- and post-Hurricane Sandy photographs. Information specialist **Rachel Pawlitz** of the USGS Southeast Ecological Science Center in Gainesville, Florida, shared information about freshwater and marine aquatic species in Florida.

Together with visitors attending MarineQuest, the annual open house held by the Florida Fish and Wildlife Conservation Commission's (FWC) Fish and Wildlife Research Institute (<**http://myfwc.com/research/**>), more than 25,000 adults and families interacted with science professionals and learned about STEM topics and careers during the week's events in downtown St. Petersburg, Florida. The joint festivities were particularly noteworthy with the passing on October 18, 2013, of **Congressman Bill Young**, who did so much to establish St. Petersburg as a hub of marine science research. (See "USGS St. Petersburg Office Dedicates New Building to Congressman C.W. Bill Young," *Sound Waves*, June 2008 <**http://soundwaves.usgs.gov/2008/06/staff5.html**>.)

The St. Petersburg Science Festival is a marine science-themed collaboration among the 14 marine science-focused institutions that together form the St. Petersburg Ocean Team (<**http://www.spoceanteam.org/**>), including the USGS St. Petersburg Coastal and Marine Science Center (<**http://coastal.er.usgs.gov/**>), the USF College of Marine Science (<**http://www.marine.usf.edu/**>), the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service Southeast Regional Office (<**http://sero.nmfs.noaa.gov/**>), and the FWC Fish and Wildlife Research Institute (<**http://myfwc.com/research/**>), among others (see "USGS Contributes to Success of St. Petersburg Science Festival in Florida," *Sound Waves*, January/February 2013 <**http://soundwaves.usgs.gov/2013/02/outreach.html**>). The Ocean Team partners recognized that as awareness of the essential role of science in everyday life continues to grow, the regional St. Petersburg Science Festival will be a valuable way for scientists to connect with the public. As Rutherford said, "The St. Petersburg Science Festival is an opportunity for our community to celebrate science by providing festival attendees with one-on-one interactions with science professionals. Who knows, maybe a future research project is prompted by a question asked by one or more of our festival participants. How exciting would that be!" Through the St. Petersburg Science Festival, the Ocean Team decided to expand their efforts beyond the marine-science community by inviting a wider range of partners to create a larger community celebrating the wonders of science. The science festival concept inspires curiosity in learners of all ages through interactive activities that astonish audiences.

Since 1999, the USGS St. Petersburg Coastal and Marine Science Center has been sharing science with the local community through its annual open house (see "USGS Celebrates 10th Annual Open House in St. Petersburg, Florida," *Sound Waves*, January/February 2009 <**http://soundwaves.usgs.gov/2009/01/outreach.html**>), and the science center continues that strong commitment as a lead collaborator and exhibitor for the St. Petersburg Science Festival.

Left to right: ***Theresa Burress*** *(CNTS), St. Petersburg Mayor* ***Bill Foster****, and Dean* ***Jackie Dixon*** *(USF College of Marine Science) help kick off Saturday's public festival with a rainbow geyser orchestrated by scientist* ***Jeff Meister*** *(Mad Science of Tampa Bay). Photograph by* ***Paul Suprenand****, USF College of Marine Science.*

Rachel Pawlitz *(USGS), foreground right, shares information about native and nonnative fish species with a family, while* ***Kara Doran*** *(USGS), background left, makes adjustments to the hurricane and extreme storms coastal-erosion model. Doran also organized the Sneak Peek for Schools event held the previous day. Photograph by* ***Paul Suprenand****, USF College of Marine Science.*

Deepwater Canyon Study Among Projects Given Prestigious DOI Partners in Conservation Award

By Helen Gibbons

The multiagency project "Atlantic Canyons – Pathways to the Abyss" (**http://oceanexplorer.noaa.gov/explorations/13midatlantic/welcome.html**) is a recipient of the 2013 U.S. Department of the Interior (DOI) Partners in Conservation Award. The Atlantic Canyons study used the remotely operated vehicle (ROV) *Jason II* and other cutting-edge tools to investigate the ecology of deepwater canyons off the U.S. mid-Atlantic coast. Little was previously known about these submarine canyons, which are pathways for nutrients, sediments, and pollutants from the continental shelf to the deep sea. (See related *Sound Waves* articles on "Life in the Abyss" and "Coral Gardens" at <**http://soundwaves.usgs.gov/2013/06/fieldwork2.html**> and <**http://soundwaves.usgs.gov/2013/06/fieldwork3.html**>.) Study participants come from 17 organizations, including the U.S. Geological Survey (USGS), the Bureau of Ocean Energy Management (BOEM), the National Oceanic and Atmospheric Administration (NOAA), the Woods Hole Oceanographic Institution (WHOI), several universities, private firms, and the North Carolina Museum of Natural Science. Principal USGS members are **Colleen Charles** (coordinator of the Terrestrial, Freshwater, and Marine Environments Program, Outer Continental Shelf), **Amanda Demopoulos** (USGS project chief), and **Cheryl Morrison**, **Christina Kellogg**, and **Nancy Prouty** (project scientists).

The Atlantic Canyons study was one of 20 partnerships recognized in 2013 from the nine bureaus of DOI. The awards recognize public-private partnerships that have achieved exemplary conservation results through cooperation and community engagement. Secretary of the Interior **Sally Jewell** presented the awards January 16, 2014, in Washington, D.C.

"The Department of the Interior is proud to recognize the accomplishments of those who are innovating and collaborating in ways that address today's complex conservation and stewardship challenges," Secretary Jewell said at the awards ceremony. "These partnerships represent the gold standard for how Interior is doing business across the nation to power our future, strengthen tribal nations, conserve and enhance America's great outdoors, and engage the next generation."

(Left to right) ***Jennifer McClain-Counts*** *and* ***Jill Bourque*** *(USGS technicians) and project chief* ***Amanda Demopoulos*** *(USGS benthic research ecologist) prepare to extract a sediment sample from one of the push cores deployed by* Jason II *during the Deepwater Canyons 2013 research cruise off the U.S. mid-Atlantic coast. Image courtesy of Deepwater Canyons 2013 - Pathways to the Abyss, NOAA-OER/BOEM/USGS.*

Additional award-winning projects that include the USGS as a partner are:

- Minute 319 Bi-National Partnership, <**http://www.usbr.gov/lc/region/feature/minute319.html**>
- Edwards Aquifer Recovery Implementation Program - Balancing the Needs of Wildlife, Water, and People, <**http://www.fws.gov/home/feature/2014/2013-pic-awards.html#Edwards**>
- Klamath Tribal Leadership Development Program for Integrative Science and Traditional Ecological Knowledge, <**http://indiancountrytodaymedianetwork.com/2014/01/27/klamath-youth-program-melding-science-and-traditional-knowledge-wins-national-award**>
- AMDTreat Software Partnership, <**http://amd.osmre.gov/**>
- Alaska Native Science and Engineering Program, <**http://www.ansep.net/**>
- Huron Erie Corridor Initiative Partnership, <**http://www.huron-erie.org/**>
- Pacific Northwest Aquatic Monitoring Partnership, <**http://www.pnamp.org/**>
- Restoring Threatened and Endangered Fishes of the Truckee River Watershed, <**http://wfrc.usgs.gov/projects/9388BQM/9/**>

Read a complete list of award winners in the DOI press release at <**http://www.doi.gov/news/pressreleases/secretary-jewell-presents-2013-partners-in-conservation-awards.cfm**>.

More details about each project and the organizations involved are available in a PDF file (856 KB) at <**http://www.doi.gov/news/upload/PIC-2013-Final-Event-Program-1-16-2014.pdf**>.

USGS oceanographer ***Nancy Prouty*** *collects water from sampling bottles deployed during the Deepwater Canyons 2013 research cruise off the U.S. mid-Atlantic coast. Image courtesy of* ***Art Howard****, Deepwater Canyons 2013 – Pathways to the Abyss, NOAA-OER/BOEM/USGS.*

Barbara Lidz Retires after Long Career with the USGS in Florida

By Gene Shinn

***Barbara Lidz**, Research Geologist and original editor of* Sound Waves *at the U.S. Geological Survey (USGS) St. Petersburg Coastal and Marine Science Center in Florida, retired in January 2014 after 39 years of service with the USGS. She is now a USGS Scientist Emerita and will continue working on Florida Keys geology with her long-time colleague and friend **Gene Shinn**, a retired USGS Geologist and currently Courtesy Professor at the University of South Florida St. Petersburg. To mark this transition, Gene compiled a personal account of Barbara's USGS career, which parallels the early history (and pre-history) of the USGS Coastal and Marine Geology Program in Florida.*

*The crew at Fisher Island Station circa 1976. Standing (left to right): **Gene Shinn**, **Barbara Lidz**, **Bonnie McGregor** (who spent a year at the station), **Harold Hudson**, and **Dan Robbin**. In front (left to right): **Charles Sheerer** and **Janos Hass**. (Hass, of the Hungarian Geological Society, spent a few months at the station.)*

It was 1974, and **Barbara Lidz** was working for **Cesare Emiliani** at the Rosenstiel School of Marine and Atmospheric Science, University of Miami, identifying minute shells of planktic foraminifera. These one-celled marine organisms, commonly called "forams," provide information on the geologic age of the rock or sediment in which they are found. Cesare's National Science Foundation funding was running on empty, and he was worried about the future of Barbara and the young daughter she was raising on her own after her micropaleontologist husband had succumbed to leukemia.

Cesare had heard about the arrival of a small USGS unit that was looking for a secretary. At the time, we were housed just across the street from the Rosenstiel School in temporary quarters in the new National Oceanic and Atmospheric Administration (NOAA) Atlantic Oceanographic and Meteorological Laboratory (AOML) on Virginia Key. **Bob Halley** and **Harold Hudson** were already onboard, and all three of us [Halley, Hudson, and the author, Gene Shinn] were squeezed into a small office, wondering where we might find permanent quarters. Cesare called me about Barbara and told me that besides identifying forams, Barbara was also a secretary. What he meant was that she served as Secretary for the Miami Geological Society. He added, "She went to Smith College, can do most anything, and has a photographic memory for planktic foraminifera."

Our little fledgling group, newly created within the then USGS Oil and Gas Branch, knew that petroleum geologists had little interest in planktic forams, which drift in the deep waters of the open oceans. They were more interested in benthic forams, which live in and on seafloor sediment and provide information on the water depths and depositional environments in which they lived. We were undecided. For her interview, she brought her portfolio of published papers and microfossil drawings—this was in the days before scanning electron microscopes. Barbara said that she could learn about benthic forams, and besides, "I can serve as secretary, type manuscripts, and prepare graphics." (At the time, we used typewriters for manuscripts and Zip-a-Tone transfers for scientific illustrating. Lettering was done with Leroy sets—older geologists will remember those.)

But we were concerned. Would hiring a female foram expert who had attended Smith College to do part-time secretarial work become a problem? Cesare had assured us that it would not. Barbara assured us she could handle it all. **Pete Rose**, then head of the Oil and Gas Branch in Denver, gave us the green light, and Barbara became a key member of our group.

A few weeks later, we found a new home. It was abandoned quarantine-service housing under lease to the University of Miami. The housing was on nearby Fisher Island, created when dredging of the main seaway into the Miami harbor severed and isolated the south end of Miami Beach. The quarantine service had moved its operations to the Miami airport, leaving six Spanish-style houses and a large office building on 14 acres of prime waterfront property. There were also a machine shop, a boathouse, and a laboratory building that had housed a microbiology project. In the large office building was none other than **Robert N. Ginsburg**, geologist and reigning master of modern carbonate sedimentology. The work of Bob and his many students included research on oil and gas resources, so we felt right at home. A caretaker and his wife lived in the house next to the one in which we set up our offices. The caretaker ran the ferryboat, the only way on or off the island. The ferry was an open pontoon boat with a Bimini top, powered by two outboard motors, and it ran every hour on the hour, rain or shine. It would rule our lives for the next 15 years!

We moved into one of the houses, with Barbara working in what had been the living room. She had a fireplace, a front

(Barbara Lidz continued on page 17)

(Barbara Lidz continued from page 16)

porch, and a private bathroom. Four former bedrooms served as offices off a fully equipped kitchen. The USGS Fisher Island Station was open for business!

During our 15-year tenure on the island, Barbara did get to exercise her knowledge of planktic foraminifera. She traveled to St. Croix in the Virgin Islands to help **Robert F. Dill**, director of the then West Indies Laboratory of Fairleigh Dickinson University, determine the ages of some uplifted deepwater sedimentary rocks. As a result of that study, Barbara published five journal papers, one of which described the oldest marine deposits found on the island, with ages of early Eocene to early Miocene (see <**http://pubs.usgs.gov/gip/141/**> to convert geologic ages into years before present). Those deposits were discovered as a mudball encased by mid-Miocene turbidite layers (turbidites form when sediment mixed with water flows downslope as a density current and spreads out on the seafloor). That paper also demonstrated the importance of examining reworked sediments (older sediments eroded and then re-deposited with younger sediments)—the mudball remains the oldest marine deposit found to this day on St. Croix.

Barbara was later invited, as the USGS expert in planktic biostratigraphy, to aid Bob Ginsburg and his group of international experts in determining the precise ages of Tertiary limestone in two borehole cores they had recovered from the western margin of the Great Bahama Bank. Her analysis of the planktic forams yielded late Neogene ages that spanned approximately 4 million years, from about 5.7 to 1.6 million years ago. This was after other researchers' efforts to date those cores, using a variety of sophisticated techniques, had failed.

In the process of dating the cores, Barbara found that abundant older (Paleogene) forams had been reworked into the late Neogene host rock. Her discovery completely upended the long-standing theory of the evolution of the western margin of the Great Bahama Bank, which had been envisioned simply as a seaward accumulation of sediments shed from the banktop during high stands of sea level. She amassed evidence to produce a far more complex model involving multiple regional processes, spanning a period of more than 64 million years (approximately 66 to 1.9 million years ago), from which she reconstructed the geologic history of that part of the Caribbean. Once again, reworked microfossils played a major role, enabling those significant ancient events to become "visible" and interpretable from within the narrow confines of the late Neogene window. None of the other studies on the cores could have detected the fossil evidence that led to this breakthrough.

When her eyes were not glued to the microscope, Barbara kept our crew together. In addition to making core logs from oil-well cuttings and identifying and cataloging sediment components in cores and sediment samples, she paid the bills, balanced the books, filled out purchase orders, and answered the phone. Thanks to proximity, an intercom was not needed. It was simply, "Hey Bob, [or Harold, or Gene,] pick up the phone!"

Having served aboard seagoing University of Miami research vessels, Barbara was used to the ocean and never got seasick. She did not scuba dive, and she abhorred giving oral presentations on field trips or at meetings, but she ruled committee meetings with a stern hand. She never put off anything for later if she could do it now! That quality enforced the kind of discipline the rest of us needed. In her spare time, Barbara was elected President of the Miami Geological Society and eventually held every position on its board of directors. And there was the international Society for Sedimentary Geology, then

(Barbara Lidz continued on page 18)

(Left to right) ***Dan Robbin, Gene Shinn****, and* ***Barbara Lidz*** *make the 45-minute climb to their tripod drill rig at the top of Scorpion Mound near Tularosa in the Sacramento Mountains of New Mexico. Photograph by* ***Steve Earley*** *in 1981.*

While Scorpion Mound was being drilled (background), Barbara used a binocular microscope to examine core segments as they came out of the ground. A continuous 54-foot (16.4-meter) core penetrated the entire mound (46 feet, or 14 meters, thick). Scorpion Mound consists of calcareous phylloid algal plates and collapse breccia overlying a topographic high of massive sandstone. Photograph by ***Steve Earley****.*

(Barbara Lidz continued from page 17)

called the Society of Economic Paleontologists and Mineralogists. (It is still known as SEPM.) The organization needed an editor for papers in its series of Special Publications, a.k.a. "the red books." She ran for office and was elected. During her two-term 8-year tenure, she edited papers in more than a dozen Special Publications volumes and served on the SEPM Executive Council as chair of the Publications Committee. We benefited from her editing skills as well; she edited all 65 papers that we published during the first 10 years on the island.

During the Fisher Island days, we made cruises to Central America, where we cored and sampled the Belize barrier reef. We also conducted numerous research cruises to the Bahamas and Andros Island tidal flats. For the fieldwork, we chartered a 50-foot trawler and towed our 25-foot research vessel (R/V) *Halimeda*. A side activity was producing several USGS training films. Barbara starred in one 1994 film in which she sampled bottom sediments using a robotic arm extending from a two-person submersible. The project was a study of effects of exploratory-well drilling on bottom habitats and communities in the Gulf of Mexico (resulting in USGS Open-File Report 94–130 <**http://pubs.er.usgs.gov/publication/ofr94130**>).

A more unusual trip was trailering our coring equipment to New Mexico. There, with the help of a local helicopter pilot, we hoisted equipment to the tops of two cactus-encrusted bioherms (mound-like fossil reefs) in the Sacramento Mountains outside Tularosa and Alamogordo. We cored through a famous Permian patch reef, locally called Scorpion Mound, and the much larger Mississippian deepwater reef called Muleshoe Mound. Both were well-known training areas for petroleum geologists, and their origins had not been accurately determined. Barbara did it all, including the daily 45-minute climb to the drill rig situated at the highest points on the mounds.

The inevitable sad day came in 1989. We were leaving Fisher Island. The university was selling the property, and we were being transferred to join other USGS scientists in the newly created Center for Coastal Geology in St. Petersburg, Florida. Why St. Petersburg? The location had been picked by none other than Bob Halley, who had begun his career with us on Fisher Island and had most recently served as Chief of the then Branch of Atlantic Marine Geology in Woods Hole, Massachusetts, before moving to St. Petersburg. He, **Abby Sallenger** (<**http://soundwaves.usgs.gov/2013/02/staff.html**>), and **Bonnie McGregor**, who also had worked with us on Fisher Island and later became associate director of the USGS, had put together an agreement with the nearby University of South Florida (USF) College of Marine Science (CMS). **Jack Kindinger**, who had replaced Bob at Fisher Island, had paved the way and moved to St. Petersburg a year earlier.

***Barbara Lidz** holds a section of core from Muleshoe Mound near Alamogordo, a few miles south of Scorpion Mound. The center of Muleshoe Mound, more than 328 feet (100 meters) thick, consists of extremely dense limestone composed of fenestrate bryozoan and crinoid fossil debris, with varying proportions of fine-grained matrix. At this site, the drillers recovered 68.9 feet (20.8 meters) of core in 5-foot (1.5-meter) sections. Muleshoe Mound accumulated in deep water as evidenced by the lack of algae, which require sunlight. Photograph by **Steve Earley**.*

We soon found ourselves in a newly renovated, redbrick, 1925-era building next to the USF St. Petersburg campus. The building had formerly been a Studebaker auto dealership. Once settled in, we were back to doing research in South

(Barbara Lidz continued on page 19)

*Screen captures from an early USGS training video. (Left) **Barbara Lidz** exits the two-person submersible* Delta *after diving to 200 feet below sea level to explore areas along the shelf off the west coast of Florida in the Gulf of Mexico. (Right) Using the robotic arm of the submersible* Delta*, Barbara collects bottom sediment from around exploratory-well sites drilled off the west coast of Florida in 1981 and 1986 in 53 and 70 meters (174 and 230 feet) of water, respectively. Conducted in 1988, the study examined the impact of drill cuttings and drilling debris on benthic habitats and marine communities. Samples examined under a binocular microscope showed no evidence of drill cuttings. Measurable environmental perturbation was limited to mechanical effects of debris discarded from the drill rigs. (A report prepared for the Bureau of Ocean Energy Management [then Minerals Management Service] is posted as a 20-MB PDF file at <**http://www.data.boem.gov/PI/PDFImages/ESPIS/1/1027.pdf**>.) Images from USGS Open-File Report 94–130 (<**http://pubs.er.usgs.gov/publication/ofr94130**>) were captured and enhanced by **Betsy Boynton**, Cherokee Nation Technology Solutions (CNTS) contractor to USGS.*

(Barbara Lidz continued from page 18)

Florida. At that time, the work was fueled by a major Everglades restoration project that included both coral reef and groundwater research.

Barbara continued to edit papers for us and for new USGS colleagues in the St. Petersburg center. Her major project, however, was the compilation of all USGS research and some classic studies by others into a one-source digital geologic record that showed a fluctuating sea level and shelf-wide evolution of the Florida Keys and reef tract over the past 325,000 years (<**http://pubs.usgs.gov/pp/2007/1751/**>). One of many results was preparation of a huge benthic-habitat map of the Florida Keys National Marine Sanctuary, which was installed on a long wall at the USF CMS. The project included her leading a one-month cruise to the Keys as principal investigator, collecting (and later interpreting) many kilometers of high-resolution seismic lines, merging of the new data with previously published data, and contouring Holocene reef and sediment thicknesses and the surface of the underlying 80,000-year-old Pleistocene bedrock by hand. Much of the work was done in cooperation with the USF CMS. By then, we had converted to the digital world. Typewriters and Zip-a-Tone were history.

Barbara Lidz *works on a manuscript while underway in the Florida Keys aboard the trawler* Sea Angel *(skippered by* ***Captain Roy Gaensslen****, who frequently served as charter captain for the USGS; see <****http://soundwaves.usgs.gov/2001/08/staff.html****>). The* Sea Angel *is towing a rubber Zodiac raft and the 25-foot USGS work boat R/V* Halimeda*, barely visible out the back door to the right. Photograph by* ***Gene Shinn*** *circa 1977.*

With all this varied background, 39 years of service, and more than 150 papers on her own research published in peer-reviewed journals or as comprehensive stand-alone book chapters (<**http://sofia.usgs.gov/bibliography/lidz.html**>), Barbara retired on January 25, 2014, but not to tend her garden. She has taken an Emerita position in that old Studebaker building she knows so well. She did not want a farewell party, and since Barbara has always been a "workaholic," she looks forward to the work in the Florida Keys that still needs to be done. She has thoroughly enjoyed her lifetime adventures as a Research Geologist.

The many awards that Barbara received during her USGS career include a Blue Pencil Award (Second Place, Internal-Newsletter Category), sponsored by the National Association of Government Communicators (NAGC); and the Shoemaker Award for Excellence in Internal Communication. These two honors were bestowed in 2004 for being contributing editor to the highly successful Bureau-wide newsletter Sound Waves. ❁

Recently Published Articles

Andrews, B.D., Chaytor, J.D., Brothers, D.S., and ten Brink, U.S., 2013, Bathymetric terrain model of the Atlantic margin for marine geological investigations: U.S. Geological Survey Open-File Report 2012–1266, doi:10.3133/ofr20121266 [**http://dx.doi.org/10.3133/ofr20121266**].

Anemaet, E.R., and Middleton, B.A., 2013, Dendrometer bands made easy—Using modified cable ties to measure incremental growth of trees: Applications in Plant Sciences, v. 1, no. 9, doi:10.3732/apps.1300044 [**http://dx.doi.org/10.3732/apps.1300044**].

Brock, J.C., Barras, J.A., and Williams, S.J., 2013, Introduction to the special issue on "Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico," *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 1–5. doi:10.2112/SI63-001.1 [**http://dx.doi.org/10.2112/SI63-001.1**].

Brothers, D.S., Ruppel, C., Kluesner, J.W., Chaytor, J.D., tenBrink, U.S., Hill, J.C., Andrews, B.D., and Flores, C., 2014, Seabed fluid expulsion along upper slope and outer shelf of the U.S. Atlantic continental margin: Geophysical Research Letters, , doi: 10.1002/2013GL058048 [**http://dx.doi.org/10.1002/2013GL058048**].

Cheriton, O.M., McPhee-Shaw, E.E., Shaw, W.J., Stanton, T.P., Bellingham, J.G., and Storlazzi, C.D., 2013, Suspended particulate layers and internal waves over the southern Monterey Bay continental shelf—An important control on shelf mud belts?: Journal of Geophysical Research–Oceans, published online January 21, 2014, doi:10.1002/2013JC009360 [**http://dx.doi.org/10.1002/2013JC009360**].

Cobb, R.M., DeLong, K.L., Richey, J.N., Flannery, J.A., Kilbourne, K.H., Smith, J.M., Quinn, T.M., and Hudson, J.H., 2013, A spatial and vertical comparison of coral Sr/Ca variations and growth rates in *Montastraea faveolata* colonies in Veracruz, Mexico [abs.]: American

(Recently Published continued on page 20)

(Recently Published continued from page 19)

Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for PP31A-1838.

Couvillion, B.R., and Beck, H., 2013, Marsh collapse thresholds for coastal Louisiana estimated using elevation and vegetation index data, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 58–67, doi:10.2112/SI63-006.1 [**http://dx.doi.org/10.2112/SI63-006.1**].

Dalyander, P.S., Long, J.W., Plant, N.G., and Thompson, D.M., 2013, Appendix D—Use of wave scenarios to assess potential Submerged Oil Mat (SOM) formation along the coast of Florida and Alabama, *in* Operational Science Advisory Team (OSAT3) investigation of recurring residual oil in discrete shoreline areas in the Eastern Area of Responsibility: Report prepared for Thomas Sparks, CAPT, U.S. Coast Guard, 63 p. plus appendices [**http://www.restorethegulf.gov/release/2014/01/15/operational-science-advisory-team-report-iii**].

Dalyander, P.S., Long, J.W., Plant, N.G., and Thompson, D.M., 2014, Estimating the potential cross-shore distribution of oil mat formation in the surf zone during the Deepwater Horizon oil spill [abs.]: 2014 Gulf of Mexico Oil Spill and Ecosystem Conference, Mobile, Alabama, January 26–29, 2014 [**http://gulfofmexicoconference.org/wp-content/uploads/2013/01/GulfOilSpillEcosystemAbstracts_2014.html**].

DeLong, K.L., Flannery, J.A., Quinn, T.M., Maupin, C.R., Lin, K., and Shen, C., 2013, Sea surface temperature variability in the Gulf of Mexico from 1734-2008 CE—A reconstruction using cross-dated Sr/Ca records from the coral *Siderastrea siderea* [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for PP42A-02.

Duberstein, J.A., Conner, W.H., and Krauss, K.W., 2013, Woody vegetation communities of tidal freshwater swamps in South Carolina, Georgia and Florida (US) with comparisons to similar systems in the US and South America: Journal of Vegetation Science, published online September 13, 2013, doi:10.1111/jvs.12115 [**http://dx.doi.org/10.1111/jvs.12115**].

Elston, L.M., Waddle, J.H., Rice, K.G., and Percival, H.F., 2013, Co-occurrence of invasive Cuban treefrogs in PVC pipe refugia: Herpetological Review, v. 44, no. 3, p. 406-409 [**http://pubs.er.usgs.gov/publication/70048718**].

Field, M.E., Storlazzi, C.D., Cacchione, D.A., Logan, J.B., Rubin, D.M., Wilson, P., and Black, K., Fine-grained sediment transport on a fringing coral reef flat as elucidated by sediment tracers and oceanographic measurements [abs.]: Ocean Sciences Meeting, Honolulu, Hawai'i, February 23–28, 2014 [**http://www.sgmeet.com/osm2014/viewabstract.asp?AbstractID=13869**].

Flannery, J.A., and Poore, R.Z., 2013, Sr/Ca proxy sea-surface temperature reconstructions from modern and Holocene *Montastraea faveolata* specimens from the Dry Tortugas National Park, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 20–31, doi:10.2112/SI63-003.1 [**http://dx.doi.org/10.2112/SI63-003.1**].

Garrison, V.H., Majewski, M.S., Foreman, W.T., Genualdi, S.A., Mohammed, A., and Massey Simonich, S.L., 2014, Persistent organic contaminants in Saharan dust air masses in West Africa, Cape Verde and the eastern Caribbean: Science of the Total Environment, v. 468–469, p. 530–543, doi:10.1016/j.scitotenv.2013.08.076 [**http://dx.doi.org/10.1016/j.scitotenv.2013.08.076**].

Geist, E.L., and Parsons, T., 2014, Undersampling power law size distributions—Effect on the assessment of extreme natural hazards: Natural Hazards, 31 p., published online January 2014, doi:10.1007/s11069-013-1024-0 [**http://dx.doi.org/10.1007/s11069-013-1024-0**].

Gesch, D.B., 2013, Consideration of vertical uncertainty in elevation-based sea-level rise assessments—Mobile Bay, Alabama case study, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 197–210, doi:10.2112/SI63-016.1 [**http://dx.doi.org/10.2112/SI63-016.1**].

Gieder, K.D., Karpanty, S.M., Fraser, J.D., Catlin, D.H., Gutierrez, B.T., Plant, N.G., Turecek, A.M., and Thieler, E.R., 2014, A Bayesian network approach to predicting nest presence of the Federally-threatened Piping 1 Plover (*Charadrius melodus*) using barrier island features: Ecological Modeling, v. 276, p. 38–50, doi:10.1016/j.ecolmodel.2014.01.005 [**http://dx.doi.org/10.1016/j.ecolmodel.2014.01.005**].

Glick, P., Clough, J., Polaczyk, A., Couvillion, B., and Nunley, B., 2013, Potential effects of sea-level rise on coastal wetlands in southeastern Louisiana, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 211-233, doi:10.2112/SI63-0017.1 [**http://dx.doi.org/10.2112/SI63-0017.1**].

Griffin, D.W., Gray, M.A., Lyles, M.B., and Northup, D.E., 2014, The transport of non-indigenous microorganisms into caves by human visitation—A case study at Carlsbad Caverns National Park: Geomicrobiology, v. 31, no. 3, p. 175–185, doi:10.1080/01490451.2013.815294 [**http://dx.doi.org/10.1080/01490451.2013.815294**].

Guy, K.K., Stockdon, H.F., Plant, N.G., Doran, K.S., and Morgan, K.L.M., 2013, Hurricane Isaac—Observations and analysis of coastal change: U.S. Geological Survey Open-File Report 2013–1270, 21 p., doi:10.3133/ofr20131270 [**http://dx.doi.org/10.3133/ofr20131270**].

Hapke, C.J., Brenner, O., and Schwab, W.C., 2013, Influences on the morphologic

(Recently Published continued on page 21)

(Recently Published continued from page 20)

response to Hurricane Sandy—Fire Island, NY [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for OS33C-02.

Hein, J.R., and Koschinsky, A., 2014, 13.11—Deep-ocean ferromanganese crusts and nodules, *in* Elias, S.A., ed., Reference module in Earth systems and environmental sciences, *from* Holland, H., and Turekian, K., eds., Treatise on geochemistry (second edition): Oxford, Elsevier Ltd., v. 13, p. 273–291, doi:10.1016/B978-0-08-095975-7.01111-6 [**http://dx.doi.org/10.1016/B978-0-08-095975-7.01111-6**].

Jiang, J., DeAngelis, D., Anderson, G., and Smith, T.J., III, 2014, Analysis and simulation of propagule dispersal and salinity intrusion from storm surge on the movement of a marsh-mangrove ecotone in south Florida: Estuaries and Coasts, v. 37, no. 1, p. 24–35, doi:10.1007/s12237-013-9666-4 [**http://dx.doi.org/10.1007/s12237-013-9666-4**].

Kindinger, J.L., 2014, Subsidence and coastal geomorphic change in central Louisiana [abs.]: Underground Injection Control Conference, New Orleans, La., January 21–23, 2014.

Krebs, J.M., McIvor, C.C., and Bell, S.S., 2013, Nekton community structure varies in response to coastal urbanization near mangrove tidal tributaries: Estuaries and Coasts, doi:10.1007/s12237-013-9726-9 [**http://dx.doi.org/10.1007/s12237-013-9726-9**].

Kumar A., Abouchami, W., Galer, S.J.G., Garrison, V.H., Williams, E., and Andreae, M.O., 2014, A radiogenic isotope tracer study of transatlantic dust transport from Africa to the Caribbean: Atmospheric Environment, v. 82, p. 130–143, doi:10.1016/j.atmosenv.2013.10.021 [**http://dx.doi.org/10.1016/j.atmosenv.2013.10.021**].

Lacy, J.R., Gladding, S., Brand, A., Collignon, A., and Stacey, M.S., 2014, Lateral baroclinic forcing enhances sediment transport from shallows to channel in an estuary: Estuaries and Coasts, 20 p., published online January 2014, doi:10.1007/s12237-013-9748-3 [**http://dx.doi.org/10.1007/s12237-013-9748-3**].

Lisle, J.T., 2014, Survival of bacterial indicators and the functional diversity of native microbial communities in the Floridan aquifer system, south Florida: U.S. Geological Survey Open-File Report 2014–1011, 72 p., doi:10.3133/ofr20141011 [**http://dx.doi.org/10.3133/ofr20141011**].

Lizza, K., Zawada, D.G., and Hine, A.C., Comparison of the historical and current distribution of *Acropora cervicornis* in relation to climatic parameters and habitat characteristics: Ocean Sciences Meeting, Honolulu, Hawaii, February 23–28, 2014 [**http://www.sgmeet.com/osm2014/viewabstract.asp?AbstractID=13078**].

Miselis, J.L., Ganju, N.K., Navoy, A., Nicholson, R., and Andrews, B.D., 2013, Superstorm Sandy-related morphologic and sedimentologic changes in an estuarine system—Barnegat Bay-Little Egg Harbor Estuary, New Jersey [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for OS33C-07.

Morgan, K.L.M., Krohn, M.D., Doran, K., and Guy, K., 2013, Baseline coastal oblique aerial photographs collected from Pensacola, Florida, to Breton Islands, Louisiana, February 7, 2012: U.S. Geological Survey Data Series 799 [**http://pubs.usgs.gov/ds/0799/**].

Palaneasu-Lovejoy, M., Kranenburg, C., Barras, J.A., and Brock, J.C., 2013, Land loss due to recent hurricanes in coastal Louisiana, U.S.A., *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 97–109, doi:10.2112/SI63-009.1 [**http://dx.doi.org/10.2112/SI63-009.1**].

Plant, N.G., and Guy, K.K., 2014, Change in the length of the southern section of the Chandeleur Islands oil berm, January 13, 2011, through September 3, 2012: U.S. Geological Survey Open-File Report 2013–1303, 8 p., doi:10.3133/ofr20131303 [**http://dx.doi.org/10.3133/ofr20131303**].

Plant, N.G., Long, J.W., Dalyander, S., Thompson, D.M., and Miselis, J.L., 2013, Predicting geomorphic evolution through integration of numerical-model scenarios and topographic/bathymetric-survey updates [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for EP21A-08.

Plant, N.G., Thompson, D.M., Long, J.W., Dalyander, P.S., Sherwood, C.R., Morgan, K.L.M., and Guy, K.K., 2014, Barrier island evolution research project: U.S. Geological Survey web site, [**http://coastal.er.usgs.gov/bier/**].

Poore, R.Z., Tedesco, K.A., and Spear, J.W., 2013, Seasonal flux and assemblage composition of planktic foraminifers from a sediment-trap study in the northern Gulf of Mexico, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 6–19, doi:10.2112/SI63-002.1 [**http://dx.doi.org/10.2112/SI63-002.1**].

Porubsky, W., Weston, N., Moore, W., Ruppel, C., and Joye, S., 2014, Dynamics of submarine groundwater discharge (SGD) and associated fluxes of dissolved nutrients, carbon, and trace gases to the coastal zone (Okatee River estuary, South Carolina): Geochimica and Cosmochimica Acta, published online January 17, 2014, doi:10.1016/j.gca.2013.12.030 [**http://dx.doi.org/10.1016/j.gca.2013.12.030**].

Reich, C.D., Poore, R.Z., and Hickey, T.D., 2013, The role of vermetid gastropods in the development of the Florida Middle Ground, northeast Gulf of Mexico, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p.

(Recently Published continued on page 22)

(Recently Published continued from page 21)

46–57, doi:10.2112/SI63-005.1 [**http://dx.doi.org/10.2112/SI63-005.1**].

Richey, J.N., Thirumalai, K., and Quinn, T.M., 2013, A sediment trap-based study of the stable isotopic differences between two morphotypes of the planktic foraminifer, *Globigerinoides ruber* (white) in the northern Gulf of Mexico [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for PP31A-1850.

Robbins, L.L., Knorr, P.O., Daly, K.L., and Barrera, K.E., 2014, USGS field activities 11BHM03 and 11BHM04 on the west Florida shelf, Gulf of Mexico, September and November 2011: U.S. Geological Survey Data Series 822, 7 p., doi:10.3133/ds822 [**http://dx.doi.org/10.3133/ds822**].

Robbins, L.L., Knorr, P.O., Daly, K.L., Taylor, C.A., and Barrera, K.E., 2014, USGS Field Activities 11BHM01 and 11BHM02 on the west Florida Shelf, Gulf of Mexico, May and June 2011: U.S. Geological Survey Data Series 712, 7 p., doi:10.3133/ds712 [**http://dx.doi.org/10.3133/ds712**].

Ruggiero, P., Kratzmann, M.G., Himmelstoss, E.A., Reid, D., Allan, J., and Kaminsky, G., 2013, National Assessment of Shoreline Change—Historical shoreline change in the Pacific Northwest: U.S. Geological Survey Open-File Report 2012–1007, doi:10.3133/ofr20121007 [**http://dx.doi.org/10.3133/ofr20121007**].

Schwab, W.C., Baldwin, W.E., Hapke, C.J., Lentz, E.E., Gayes, P.T., Denny, J.F., List, J., and Warner, J.C., 2013, Geologic evidence for onshore sediment transport from the inner continental shelf—Fire Island, New York: Journal of Coastal Research, v. 29, no. 3, p. 526–544, doi:10.2112/JCOASTRES-D-12-00160.1 [**http://dx.doi.org/10.2112/JCOASTRES-D-12-00160.1**].

Smith, C.G., Osterman, L.E., and Poore, R.Z., 2013, An examination of historical inorganic sedimentation and organic matter accumulation in several marsh types within the Mobile Bay and Mobile-Tensaw River delta region, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 68–83, doi:10.2112/SI63-011.1 [**http://dx.doi.org/10.2112/SI63-011.1**].

Stevens, T., Paull, C.K., Ussler, W., III, McGann, Mary, Buylaert, J.-P., and Lundsten, E., 2014, The timing of sediment transport down Monterey Submarine Canyon, offshore California: Geological Society of America Bulletin, v. 126, no. 1/2, p. 103–121, doi:10.1130/B30931.1 [**http://dx.doi.org/10.1130/B30931.1**].

Steyer, G.D., Couvillion, B.R., and Barras, J.A., 2013, Monitoring vegetation response to episodic disturbance events by using multitemporal vegetation indices, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 118–130, doi:10.2112/SI63-007.1 [**http://dx.doi.org/10.2112/SI63-007.1**].

Storlazzi, C.D., Berkowtiz, P., and Elias, E.P.L., The effects of sea-level rise on waves, run-up, and inundation on atolls [abs.]: Ocean Sciences Meeting, Honolulu, Hawai'i, February 23–28, 2014 [**http://www.sgmeet.com/osm2014/viewabstract.asp?AbstractID=13665**].

Suir, G.M., Evers, D.E., Steyer, G.D., and Sasser C.E., 2013, Development of a reproducible method for determining quantity of water and its configuration in a marsh landscape, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 110–117, doi:10.2112/SI63-010.1 [**http://dx.doi.org/10.2112/SI63-010.1**].

Thatcher, C.A., Brock J.C., and Pendleton, E.A., 2013, Economic vulnerability to sea-level rise along the northern U.S. Gulf Coast, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 234–243, doi:10.2112/SI63-017.1 [**http://dx.doi.org/10.2112/SI63-017.1**].

Thirumalai, K., Quinn, T.M., Reynolds, C., and Richey, J.N., 2013, A replicated record of multi-centennial climate variability in the northern Gulf of Mexico spanning the last 4.4 kyrs from paired $\delta^{18}O$ and Mg/Ca in *G. ruber* [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for PP31A-1851.

Twichell, D.C., Flocks, J.G., Pendleton, E.A., and Baldwin, W.E., 2013, Geologic controls on regional and local erosion rates of three northern Gulf of Mexico barrier island systems, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 32–45, doi:10.2112/SI63-004.1 [**http://dx.doi.org/10.2112/SI63-004.1**].

Wang, G., Middleton, B., and Jiang, M., 2013, Restoration potential of sedge meadows in hand-cultivated soybean fields in northeastern China: Restoration Ecology, v. 21, no. 6, p. 801-808, doi:10.1111/rec.12015 [**http://dx.doi.org/10.1111/rec.12015**].

Williams, S.J., 2013, Sea-level rise implications for coastal regions, *in* Brock, J.C., Barras, J.A., and Williams, S.J., eds., Understanding and predicting change in the coastal ecosystems of the northern Gulf of Mexico: Journal of Coastal Research, special issue 63, p. 184–196, doi:10.2112/SI63-015.1 [**http://dx.doi.org/10.2112/SI63-015.1**].

Wilson, K., Adams, P.N., Hapke, C.J., Lentz, E.E., and Brenner, O., 2013, Probabilistic forecasting of coastal morphodynamic storm response at Fire Island, New York [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for EP13A-0823.

Wynn, J.G., Robbins, L.L., Knorr, P.O., Byrne, R.H., Takahashi, T., and Onac,

(Recently Published continued on page 23)

(Recently Published continued from page 22)

B.P., 2013, Ocean acidification research alongside extended continental shelf exploration in the western Arctic Ocean [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 9–13, 2013, visit [**http://fallmeeting.agu.org/2013/scientific-program-2/session-search/**], click on "Fall Meeting Program," and search for OS13B-1704.

Yoshinaga, M.Y., Holler, T., Goldhammer, T., Wegener, G., Pohlman, J.W., Brunner, B., Kuypers, M., Hinrichs, K.U., and Elvert, M., 2014, Carbon isotope equilibration during sulphate-limited anaerobic oxidation of methane: Nature Geoscience, published online January 26, 2014 (corrected online February 7, 2014), doi:10.1038/ngeo2069 [**http://dx.doi.org/10.1038/ngeo2069**].

Zawada, D.G., and Mazel, C.H., 2014, Fluorescence-based classification of Caribbean coral reef organisms and substrates: PLOS ONE, published online January 15, 2014, doi:10.1371/journal.pone.0084570 [**http://dx.doi.org/10.1371/journal.pone.0084570**].

Publications That Have Received Bureau Approval

Barnard, P., Erikson, L., O'Neill, A., and Foxgrover, A., Improvements to CoSMoS (Coastal Storm Modeling System) for determining coastal hazards due to climate change in southern and north-central California [abs.]: Headwaters to Ocean (H2O) Conference, 12th annual, San Diego, Calif., May 27–29, 2014.

Campbell-Swarzenski, P., Prouty, N.G., Mienis, R., and Ross, S.W., Lipid biomarkers track changing organic matter loads to Gulf of Mexico deep-water corals [abs.]: Goldschmidt Conference, Sacramento, Calif., June 8–13, 2014.

Cochran, S.A., Gibbs, A.E., and White, D.J., Benthic habitat mapping of the USCRTF Kā'anapali priority study area and the State of Hawai'i Kahekili Herbivore FMA, West Maui [abs.]: Hawai'i Conservation Conference, 22nd annual, Honolulu, Hawai'i, July 15–17, 2014.

Flocks, J., Kelso, K., Fosness, R., and Welcker, C., Seismic profile analysis of sediment deposits in Brownlee and Hells Canyon Reservoirs near Cambridge, Idaho: U.S. Geological Survey Open-File Report 2014–1019, 14 p.

Gibbs, A.E., Cochran, S.A., Hatcher, G., Logan, J., and Finlayson, D., What's beneath the waves? Seafloor imagery, bathymetry, and acoustic classification in the nearshore waters of the Hawaiian Islands [abs.]: Hawai'i Conservation Conference, 22nd annual, Honolulu, Hawai'i, July 15–17, 2014.

Jaffe, B.E., Richmond. B., Wilson, R., Hemphill-Haley, E., Kelsey, H.M., Peters, R., Leeper, R., and Watt, S., California marshes as recorders of paleotsunamis—Example from Pillar Point [abs.]: Seismological Society of America Annual Meeting, Anchorage, Alaska, April 30–May 2, 2014.

Kellogg, C.A., and others, Dark spot syndrome in *Siderastrea siderea* is not a bacterial disease [abs.]: American Society for Microbiology General Meeting, 114th, Boston, Mass., May 17–20, 2014.

Lacy, J.R., Takesue, R., and Stevens, A., Wave attenuation by the eelgrass *Zostera marina*—Dependence on wave energy [abs.]: Salish Sea Ecosystem Conference, Seattle, Wash., April 30–May 2, 2014.

La Selle, S., Gelfenbaum, G., Witter, R., Koehler, R., Carver, G., Briggs, R., and Engelhart, S., Using tsunami deposits to inform modeling of potential tsunamigenic earthquake rupture zones near Unalaska Island, Aleutian Islands [abs.]: Seismological Society of America Annual Meeting, Anchorage, Alaska, April 30–May 2, 2014.

Lisle, J.T., Garrison, V.H., and Gray, M.A., Evaluation of coral pathogen growth rates after exposure to atmospheric African dust samples: U.S. Geological Survey Open-File Report.

MacVean, L.J., and Lacy, J.R., Interactions between waves, sediment, and turbulence on a shallow estuarine mudflat: Journal of Geophysical Research–Oceans.

McMullen, K.Y., Poppe, L.J., Ackerman, S.D., Blackwood, D.S., and Woods, D.A., Sea-floor geology in northwestern Block Island Sound, Rhode Island: U.S. Geological Survey Open File Report 2014–1018.

Pendleton, E.A., Andrews, B.D., Ackerman, S.D., and Twichell, D.C., Bathymetry of Buzzards Bay and Vineyard Sound: U.S. Geological Survey Scientific Investigations Map 3286.

Poppe, L.J., McMullen, K.Y., Danforth, W.W., Blankenship, M.A., Clos, A.R., Glomb, K.A., Lewit, P.G., Nadeau, M.A., Wood, D.A., and Parker, C.E., Combined multibeam bathymetry data from Rhode Island Sound and Block Island Sound—A regional perspective: U.S. Geological Survey Open File Report 2014–1012.

Prouty, N.G., Swarzenski, P., Johannesson, K.H., Fackrell, J., and Palmore, C.D., Cycling of nutrients and trace metals in subterraenean estuaries of the Kona Coast, Hawai'i [abs.]: Goldschmidt Conference, Sacramento, Calif., June 8–13, 2014.

Stevens, A.W., Gelfenbaum, G.R., Miller, I.M., and Warrick, J.A., Sediment dynamics and coastal response to large-scale dam removal—Elwha River, USA [abs.]: Salish Sea Ecosystem Conference, Seattle, Wash., April 30–May 2, 2014.

Storlazzi, C.D., von Ormondt, M., and Chen, Y.-L., Numerical modeling of coral connectivity in the Maui Nui Complex of Hawaii [abs.]: Hawai'i Conservation Conference, 22nd annual, Honolulu, Hawai'i, July 15–17, 2014.

Takesue, R.K., Stevens, A.W., and Moore, B., Hydroacoustic mapping as an eelgrass *Zostera marina* ecosystem characterization tool [abs.]: Salish Sea Ecosystem Conference, Seattle, Wash., April 30–May 2, 2014.

Takesue, R.K., Wyllie-Echeverria, S., Bulthuis, D., Donoghue, C., Chan, F., Hacker, S., Hannam, M., Kaldy, J., Kenworthy, J., O'Connor, M., Short, F., Rybczyk, J., Zimmerman, R., and Thom, R., Future of Pacific Northwest seagrasses in a changing climate [abs.]: Salish Sea Ecosystem Conference, Seattle, Wash., April 30–May 2, 2014.